DAIRY PRODUCTION AND MARKETING: PROBLEMS AND PROSPECTS IN MEKELLE TOWN, TIGRAY REGION, ETHIOPIA

By

Tsegay G/Michael T/Giorgs

A Thesis

Submitted in Partial Fulfillment of the Requirements for the Master of Art Degree In

Cooperative Marketing

Adviser: R. Dayanandan, PhD

Mekelle University, College of Business and Economics

Department of Cooperative Studies

October, 2010

Mekelle

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DECLARATION

This is to certify that this thesis entitled **"Dairy production and Marketing in Mekelle Town, Tigray Region, Ethiopia"** submitted in Partial fulfillment of the requirements for the award of the degree of Master Arts, in Cooperative Marketing to the college of Business and economics, Mekelle University, through the Department of Cooperative studies, done by Mr. Tsegay G/Michael T/Giorgs, Id.No. FDA/PS 0029/00 is an authentic work carried out by Him under my guidance. The matter embodied in this project work has not been submitted earlier for award of any degree or diploma to the best of my knowledge and belief.

Name of the student: Tsegay G/Michael T/Giorgs ---------- ----------

Signature Date

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Signature Date

BIOGRAPHY

The author, Mr. Tsegay G/ Michael was born on Sep 10, 1968 in Northern Zone of Tigray in Woreda Saharti-Samre from his mother Mrs. Teberh Techane and his father Mr. G/Michael T/Giorgs. He attended his elementary and secondary school in Asmara and Atse-yohannes Comprehensive Secondary School in Mekelle. Then he joined Mekelle University in 1992 and graduated with Bachelor of Art degree in Economics. Immediately after his graduation he was employed by SOS, one of the non governmental organizations and has served for the past 6 years. After six years of service in the organization, he has joined School of Graduate Studies at Mekelle University in 2008 to pursue Master of Arts Degree in Cooperative Marketing in the Department of Cooperative Studies, college of Business and Economics.

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LIST OF ABBREVIATIONS

ADLI……Agricultural Development Led Industrialization

AI……Artificial Insemination

CSA……Central Statistics Authority

C:B……Cost- Benefit ratios

GDP……Gross Domestic Product

HH……Household Heads Head

IFAD……International Fund for Agricultural Development

MVPs……Marginal Value Products

NBE……National Bank of Ethiopia

OLS……Ordinary Least Square

SAS……Statistical Analysis System

SDDP……Small Dairy Development Program

SPSS……Statistical Package for Social Science

TLU……Tropical Livestock Unit

USD……United States Dollar

DDE……Dairy Development Enterprise

FAO……Food and Agriculture Organization

BoFED…… Bureau of Finance and Economic Development

MEDaC……Ministry of Economic Development and Cooperative

MOA……Ministry of Agriculture

FDRE……Federal Democratic Republic of Ethiopia

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ABSTRACT

DAIRY PRODUCTION AND MARKETING IN MEKELLE TOWN, TIGRAY REGIONAL STATE, ETHIOPIA

Dairy production and Marketing was studied on 168 dairy farms consisting of 85 cross breed (40 medium sizes and 45 small sizes) and 83 local breed (30 medium sizes and 53 small sizes) cows owning farms in Mekelle town. Cobb-Douglas production, cost-benefit (C: B) and break-even ratios were employed to assess resource use efficiency and profitability and financial efficiency of cross and local breed dairy farms. The regression coefficients with respect to concentrate for medium and small size cross breed farms are positive and significant at 10% level. The coefficient of dry fodder for medium size cross breed and local breed are positive and significant at 10% level. For small and medium size local breed farms, the coefficient for dry fodder is positive and significant at 5% level and labor is positive and significant at 5% level in the case of small size cross breed. For small and medium size local breed farms, the coefficient for miscellaneous are positive and significant at 10% level. There is difference between the present and optimum levels of inputs. The optimum levels of inputs with respect to concentrate are 30.21 quintal and 24.82 quintals for medium and small size cross breed farms, respectively. For dry fodder, the optimum is 32.70 quintals and 12.84 quintal for medium size cross and local breed farms, respectively. where as, 8.88 quintals for small size local breed farms. Green fodder, the optimum level is 10.88 quintals for medium size local breed farms.

The optimum level for labor is 403.12 man day for small size cross breed farms. For miscellaneous cost the optimum levels are 228.54 Birr and 336.47 Birr for medium and small size local bred farms, respectively. The C:B results indicated that cross breed farms were profitable (1.0:3.02) than local breed farms (1.0:2.18). Both medium and small categories of cross breed farms were profitable (1.0:3.45 and 1.0:2.74, respectively). In local breed medium size farms were profitable (1.0:2.19). The ratio of break-even milk output from the actual milk production for cross breed and local breed cows owning farms needed 13% of the actual milk production and 18% additional milk production over the actual milk production to cover fixed cost, respectively. Cross breed small and medium size farms needed 8% and 11% milk output and local breed small and

medium size farms requires additional 31% and 14% over the actual milk production. In conclusion, dairy cow's owner should be advised to use the optimum levels inputs and replace their indigenous cow with cross breed cow. More over, the herds should be medium size and feeding mainly depends on concentrate.

CHAPTER - I

INTRODUCTION

1.1. Back ground

Livestock production is a major contributor to economic development, especially among the developing countries, both driving economic growth and benefiting from it. As an engine of growth, it provides increased income, employment, food and foreign exchange earnings as well as better nutrition. As income increases with economic development, the share of animal products in total food budget increases faster than that of cereals. This occurs because of the relatively high-income elasticity of demand for animal products *(*Ehui S. 2008*)* .The dairy industry may be viewed as a distinct sector of the livestock economy.

Developing Countries have more than two-thirds of the world cattle population, but produce less than a quarter of the world's cow milk. Here lies the paradox. According to Yieshaq (1998), the average yields of cow milk for developing countries in 1993 were 3758 kg per cow. In the same period, although Africa and Europe have the same number of dairy cows (about 34 million heads), the total cow milk output of Europe was 10 times higher than that of Africa, mainly due to the huge differences in yield. Such a wide differences in productivity is suggesting that an all out effort has to be made to increase yield in productivity, of course with due consideration to the socio-cultural attitudes of the people. The gap that is manifested in productivity has also a similar trend in consumption in which the per capita consumption of total milk for Africa and Asia for 1993 was about 38 kg and 40 kg, respectively. These figures are, however, far lower than those for Europe and North America which are about 289 kg and 258 kg respectively *(Ibid)*. There is also a belief that total consumption of milk in the developing countries is projected to increase from 64 million metric tones in 1993 to 391 million metric tones by the year 2020, which is 138 percent increase. In the same token per capita consumption is expected to increase from 38 kg to 62 kg / person. Much of this increased demand will be in urban centers in which population is to grow at a rate of 5-6 between 1990-2025 *(Mihre, 2006)*. There are cases now that the rapid growth in consumption has been covered by imports of

substituting nature for dairy products such as powder milk *(Amha, 2008).* Moreover, the trends of population increase; income growth and urbanization will fuel this tremendous growth in demand. It is also natural that urbanization accompanied by modern style of life demands for a shifting of dietary preferences towards better quality food items such as meat, milk and eggs *(Harold G.Halcrow, 2007).*

Marketed dairy production is already increasing in the urban centers as a direct response to consumer demands either by smallholders or commercial dairy enterprises. For smallholders, dairying allows year round employment of the family labor force, and milk often plays the role of a “cash crop", hence increasing regular income *(Mahamed, 2007).*

Even though in a process of dynamic change, market oriented dairy production is facing several constraints in its sustainable development. These address the different components: animal feed resource upgrade genotype and management of reproduction, disease, marketing mechanisms, environmental impact, and policy environment.

As a consequence of the magnitude of the challenge and the good prospects of market oriented dairy production in many African countries, dairy systems have become a priority area for research and development. This could have a significant implication in bringing to a harmony-dairy production and urbanization.

With specific reference to Ethiopia, the country has the largest livestock population in Africa, and is ranked to be the ninth in the world. Yet its contribution to the economy is limited and remained to be a quantitative boost *(Amha, 2008)*. Of course, livestock, especially among the majority of the rural livelihood is a security, investment and an additional income. Like other sectors of the economy, the dairy sector in Ethiopia has passed through three phases; these include the imperial regime, characterized by almost a free market economic system and the emergence of modern commercial dairying (1960-1974), the socialist Derg regime that emphasized central economic system and state farms (1974-1991), and the current phase under the structural adjustment program and market liberalization (1991 to present), following the economic and political policy in the country. In the most recent phase, characterized by the transition towards market-oriented economy, the dairy sector appears to be moving towards a takeoff stage.

Ethiopia holds large potential for dairy development due to its large livestock Population; the favorable climate for improved, and the relatively disease-free environment for livestock. Given the considerable potential for smallholder income and employment generation from high-value dairy products, development of dairy in Ethiopia can contribute significantly to poverty alleviation and increased employment opportunity in the country. Despite the large size of cattle in Ethiopia, it remains underdeveloped and inferior in quality. The share of livestock to the agricultural domestic product is 30%. *(Regional Bureau of Agriculture, 2007).*

Per capita consumption of milk in Ethiopia is as low as 17 kg per head per year while the average figure for Africa is 38 kg per head per year (Mohamed et al., 2007). Milk and milk products are part of the diet for many Ethiopians. Getachew and Gashaw (2006) estimated that 68% of the total milk produced is used for human consumption in the form of fresh milk, butter, cheese and yogurt while the rest is given to calves and/or sold. The amount of consumption of milk and milk products vary geographically between the highland, the lowlands and level of urbanization. The demand for milk depends on many factors including consumer preference, consumer's income, population size, price of the product and price of milk substitutes. Getachew and Gashaw (2006) found that demand for milk is inelastic with respect to income and price. In general, population growth, rising real income and the like are expected to expand the demand for milk and milk products. Population in Ethiopia is estimated to grow at a rate of 2.9% per year while the urban population increases at the rate of 4.4%. Therefore, an increasing population size and consumer income in the future is expected to increase liquid milk consumption. Dairy production is an important issue in Ethiopia's-livestock-based society where livestock and their products are important source of food and income, and dairy has not been fully exploited and promoted (Tangka et al., 2006).

Since early 1990's, Ethiopia has embarked on policy reforms that aim to bring about a market-oriented economic system. Subsequently, several macro and sectoral economic policy changes were implemented. The federal government launched a national development strategy namely, Agricultural Development Led Industrialization (ADLI). This strategy seeks to bring about an improvement in the livestock sector by enhancing the quality and quantity of feed, and improved extension services, increasing livestock health

services and improved productivity of local cows by artificial insemination while preserving the indigenous breeds (Mohamed et al., 2007).

The development of dairy in Ethiopia indicates that there is a need to focus interventions more coherently. Development interventions should be aimed at addressing both technological gaps and marketing problems. Integration of crossbreed cattle to the sector is crucial for dairy development in the country. This can be achieved either through promotion of large private investment to introduce new technology, input supply and out put in the sector such as improved genotypes, feed and processing, or promotion of integration of crossbreed cattle into the smallholder sector through improving their access to improved cattle breeds, veterinary service and credit. Similarly, government should also take the lead in building infrastructure and providing technical service to dairy.

In Ethiopia the growth in milk production was mainly due to the increase in herd size (60%). Only 40% of the increase was due to improvement in productivity per animal resulting from technological intervention. This is not surprising since dairy production in the country is principally dependent on indigenous Zebu breeds. Therefore, integration of cross breed cattle to the sector is imperative for dairy development in the country. This can be achieved through promotion of large private investment in dairy farm and smallholder's dairy production. The government should promote integration of cross breed cattle in to the smallholder sector through improving their access to improved cattle breed, artificial insemination service, veterinary service and credit (Ibid).

Peri-urban and urban dairy production system is becoming an important supplier of milk products to urban centers, where the demand for milk and milk products is remarkably high. As a result of this, peri-urban and urban dairying is being intensified through the use of cross breed dairy cows, purchased and conserved feed and stall-feeding. These production systems are favored due to the proximity of the production sites to centers of high fresh milk demand, easy access to agro-industrial by- products, veterinary services and supplies (Azage et al., 2006). Nonetheless, the existing dairy farming practices in peri-urban and urban areas of the country in general and that of Mekelle in particular is largely traditional characterized by low inputs and management of indigenous genotype breed, zebu cattle that are low in milk production. However, it accounts for the greater proportion of dairy farming and milk production in peri-urban and urban areas. On the other hand,

modern dairy farming practices cover a range of intensive management practices and zero grazing. This production system also involves the use of exotic crossbreed genotypes that give high yield as compared to the traditional dairy farms. Both practices are confronted with the problem of competing for scarce resources. Nonetheless, these resources have to be optimally and efficiently utilized on the bases of their marginal value productivity in order to get maximum income from dairy enterprises (Ibid).

At the national level and the regional level (Tigray), cattle population respectively was believed to be 30 million and 3,426,269. Thus, out of the total cattle population of the country, Tigray accounts for 7.16 percent. It was also estimated that 50% of the cattle in Tigray were cows out of which 25% to be lactating for 3-4 months. This gives a total milk production of 2.4 million litters per year for a population of 4,334,996, and the total calorie intake of dairy products was below the national level *(Hailu, 2005).* With particular reference to the study area, the total livestock population of Mekelle was estimated to be about 60,000 *(Regional Bureau of Agriculture, 2007)*. It was believed that the total numbers of lactating (milking) cows were estimated to be 7,584 in which a cow gives an average of about 10 liters/day. This means there was a daily supply of 75,840 liters in the city. However, as compared to the total population of Mekelle (236,000), the supply of milk was very small regardless of the culture and milk consumption pattern of the society (Mekelle city development plan and CSA, 2007).

Efficient milk production is a key to sustainable development of dairying. Feed cost can be a major burden to use animals of good genetic merit. High disease incidence in the context of developing countries also compounds the main problem of research. In summary development and extension services in animal breeding, feeding and animal health are the core elements to underpin efficient milk production.

1.2 Statement of the Problem

Ethiopia holds large potential for dairy development due to its large livestock Population; the favorable climate for improved, and the relatively disease-free environment for livestock. Given the considerable potential for smallholder income and employment generation from high-value dairy products, development of dairy in Ethiopia can contribute significantly to poverty alleviation and increased employment opportunity in the country. The production of more milk will help to meet the needs of urban families at prices they can afford. With affordable prices, poor families, especially children are more likely to consume the quality protein and essential nutrients they need for healthy physical and mental development. However, market oriented dairy production is facing several constraints in its sustainable development, due to mainly population growth, urbanization and rising incomes accompanied by the unmet demand for nutritionally high value of milk and milk products.

The herd size kept by dairy farmers in Mekelle town is not evenly distributed. There is a herd size variation ranging from one cow to the largest size even greater than ten. The majority of farms keep up to 6 cows. It is believed that this variation in herd size in turn lead to differences in efficiency of resource use and profitability of farms. However, the variation in economic efficiency and profitability of milk production among farms of various size of this important sector in Ethiopia in general and urban dairy (Mekelle) in particular has not been extensively studied in the region and Mekelle town. Even though dairy farms are a source of income and job creation opportunities to the dwellers and dairy farms households, the variation in cost, return and usage of important inputs between traditional (local) and modern(cross) urban dairy farms need the gap to be filled. Hence it is essential to assess the status of dairy farming and marketing in Mekelle.

Urbanization gives rise to numerous problems which researchers, political leaders, government institutions and policy makers are trying to resolve among which dairying needs due attention. Yet, dairying in Mekelle which constitutes smallholders and commercial enterprises faces interlinked constraints in the process of production, distribution and / or marketing aspects. Hence this study is focused on the impact of issues such as the herd size, breed type and the input use of the dairy farms in Mekelle.

1.3. The Research Questions

The following questions guide the frame work of the research with due consideration to dairy production.

- Is Dairy farming in Mekelle contributing on employment and income generation?
- What is the difference in performance between small and medium dairy farms?
- Which herd size is more profitable, efficient and be promoted?
- Which breed type (local or cross breed) is efficient in input use?
- Which input resources are critically limiting the production of different breeds?
- What challenges are faced by dairy farms?

1.4. Objectives

General Objective: The general objective of the study is to assess and analyze situation of dairy production and marketing efficiency, and its problems and prospects in Mekelle.

Specific objectives:

- To assess the over all dairy cattle population and milk production in Mekelle.
- To assess the profitability of local and cross breed dairy farms of varying sizes (small and medium).
- To evaluate the contribution of dairy production on employment and income generation.
- To pinpoint the challenges faced by dairy farmers in Mekelle.

1.5. The Research Hypotheses

The following hypotheses guide the framework of the research with due consideration to dairy production.

a) Performance of herd size (small and medium) in terms of profitability and efficiency significantly differs.
b) Dairy farming in Mekelle provides employment opportunity and income generation.
c) The local breed type is efficient in input use.
d) Input resources are critically limiting the production of different breeds.

1.6. Scope of the Study

This study is conducted on two categories of dairy farms (small and medium farms) in Mekelle. The Research mainly focused on the situational assessment and analyses of dairy production and distribution, marketing with due consideration to Mekelle city. It attempts to address the efficiency differentials between small and medium size farms comprising both traditional (local cows) and modern (cross breed) dairy cows.

1.7. Significance of the Study

This study attempts to evaluate and compare the financial efficiency and profitability of different size and type of dairy farms in the Mekelle town and identify constraints and opportunities to improve profitability of the farms. The results thus help to devise and guide producers as to which part of the business deserve special attention to make improvements and to select the optimum size (small or medium) and type of farm (local or cross) for best profitability given the resources available.

Knowing the financial efficiency and profitability of dairy farms help to identify opportunities and constraints that can be used as input information to device improvement strategies that intensify dairy farms in Mekelle. Therefore, the results of the present study can be extended to other parts of the country. Hence, these results can be used by policy makers, government and Non-government organizations to streamline intervention for urban dairy production in the country in general and for the study area in particular. Moreover, considering the growing interest of intensifying urban dairying in the country and the region, this study can be used as a springboard or baseline to conduct similar other studies.

1.8. Limitation of the Study

The study has been conducted in Mekelle . Since socio-economic conditions prevailing in the peripheral regions of Ethiopia are different; the results cannot be generalized to other regions of Ethiopia.. The distribution of cattle are skewed between regions as well as with in zones of Tigray. To this end western zone (1,148,649) has the highest cattle population followed by central zone (809,230) and southern zone (725,144) and eastern zone (354,921). There are geographic and weather differences too in addition to differences in the performance of dairy farmers, thus the study can not be generalized to Tigray region also.

Other limitation of the study is that during data collection, the respondents were not forthcoming about wealth and property acquisition. None of the respondents put their wealth in monetary terms or even in kind rather they stated them in general terms. The general terms are; sending children to school; buying furniture for the house and daily household expenses are among others. In addition the small holders and the enterprises had not regular and yearly financial audit report which posed limitation to estimate the financial performance of respective dairy.

CHAPTER - II

LITERATURE REVIEW

2.1. The Concept and Systems of Dairy Production

2.1.1. The Concept of Dairy Production

The study of domestic animals can be divided broadly into animal science and animal production; dairying (milk production) is there fore part of animal production which is the main concern of this study. Animal production is the study of livestock farms and farming systems that include social, economic and political aspects, land tenure, mixed farming system and integrated land use. As a major part of livestock production, dairying (milk production) is a concept that deals with all the activities of rearing, husbandry and management, feed and feeding of animals in the development of dairy production. The performance of dairy development activities may not be the same at all levels and in all agro-ecological zones. It rather varies based on the systems of dairy production- the way it is intended for, tackling constraints, management and alike activities *(Richard W. 2007).*

Dairy cattle are kept all over the world. Keeping a dairy (milk) cow can be very lucrative, especially in urban and peri-urban areas. Hence, milk sometimes, is referred to as " a cash crop" or "white gold." The dairy cow is, however, a very valuable animal and owning one entails a number of risks. The biggest risk is losing the animal. Low productivity due to bad management will also lead to losses. And hence the costs involved in making cattle profitable are considerable. In order to make a decision on whether to make up dairy cattle farming, one could raise the following questions:

- How is the availability and accessibility, of production factors and inputs, since dairying requires more inputs and more regular labor than beef cattle?

- What are the local marketing possibilities?

-Can you sell the products all year round or only in a certain period? *(Puck Bonnier, 2006).*

2.2. Market Oriented Dairy Farms In Urban and Peri - Urban Areas

It is important to note that dairy farming is not taken as major economic stay of the farmers in the rural areas; rather it is mostly treated as complementary. Such a trend is also observed in urban centers. Dairy farming in this case is far different from that of the traditional nature.

The types of cows in Tigray before some years were ***Begait*** until the exotic types were introduced (like Segmental, Brown Swiss, and Holstein Frsiens). The development or progress so far shown since its beginning is believed to be unsatisfactory in which demand proceeds supply due to high rate of population growth in most urban centers including Mekelle *(Amha Kassahun, 2008).*

In general urban dairy farming can be categorized into two.

i. **Intensive or commercial enterprises** (enterprises that have relatively modern management systems and supply better quality milk and milk products to the market than that of **smallholdings.**)
ii. **Semi- intensive or smallholdings.**

In terms of: number of cattle, breed types, management, feeding and other similar features as follows

2.2.1. Smallholder dairy farming system

The objective of many dairy farms is to maximize profitability. Smallholder farming has proved it to be a means to mitigate poverty and food insecurity among poor households in Asian countries. This addresses the policies and strategies of the Federal Democratic Republic of Ethiopia (FDRE) government in launching livestock development schemes both in the rural and urban areas *(Amha, 2008).*

Smallholder dairy farming sometimes is designated to as a system with low input and low output; i.e. it is less intensive as compared to the commercial intensive dairy system, which is in contrary characterized by high inputs and high output.

- The smallholders in most cases are landless. Many people who do not own land, other than perhaps the very small plot on which they live. Landless livestock dairy production is a common feature in the urban centers of the developing countries (R.Trevor, 1995). Land, here, could either be grazing land, feed resource land or even barren (housing) because of the very nature of scarce land in urban centers.

- Milk cattle, in particular, appear to be gaining in importance as the urban demand for milk rises. Where dairy cattle are found in urban systems there is normally insufficient feed available for them to produce satisfactory levels of milk, and thus some degree of intensification like that of the cases of ***Kalamino*** and ***Agazi*** Dairy farms in **Mekelle** takes place. On the other hand, intensification only rarely benefits producers among the smallholders, who find themselves progressively less, rewarded for both their labor and their investment.
- Milk is sold by door- to- door delivery, contractual basis or supplied to dairy processing plants like in Addis Ababa.
- The system in the stallholders is far from perfect relatively. There are problems with the supply of feed of adequate quality, health and hygiene.
- Dairying allows year-round employment in which family labor force is most required and plays the role of a "cash crop" that insures regular income to the producer.
- Market factors play a major part in determining the type of dairy production systems, and the smallholders in the urban and peri- urban areas are governed to such reality.
- Smallholder dairy farmers could be well successful in the presence of government and nongovernmental institutions. These include, appropriate pricing and market policy, facilitating institutions, agricultural extension in providing information, training necessary to support in accessing technological change, veterinary services, efficient markets for inputs and outputs, credit institutions and the like ***(Gashaw, 2006).***

The total smallholder milk production in Ethiopia is shown in the following table.

Table 2.1: Total small-holder milk production in Ethiopia

Year	1996/97	1998/99	2000/01	2002/03	2004/05	2006/07	2008/09	Av.growth rate (1996-2009)
Liters in millions	998.9	1,039	1,054	1,091	1,331	1,171	1,219	1.2

Source: Ministry of Economic Development and cooperation, 2009

2.3. Dairy Feed and Feeding Systems

Forage and fodder species could be widely used for livestock production with the existing feeding systems. Feed and feeding systems of cattle are not uniform in the rural and urban areas. Though there are similarities, differences happen to exist, as a result of the differences of the very objectives of milk production in the respective areas. Production of milk in the urban and peri- urban areas is solely market/ profit oriented. Therefore, this trend is directly manifested on feed and feeding systems.

The major feed resources available in most developing countries in the tropic are crop residues, pasture or agro-industrial by products. Practical strategies for improving milk production of dairy animals on these diets depend on supplementation, of course, at the expense of increasing cost that could be counterbalanced by higher output (***Puck Bonnier, 2006***).

There was no significant forage development program in central Tigray before 1991. Before this time, farmers were using their own traditional practices in feeding their livestock. (***Bureau of Agriculture and Natural Resources***).

Dairy feeding system in the urban centers sometimes is referred to as ' zero grazing ' or ' cut-and carry-system', which is common among the **intensive** production system. Intensive systems also use sown pastures on large farms where land is owned and if milk production can compute with grain crop cultivation as form of land use.

In brief, forage resources include:

- natural pasture
- artificial pasture
- cultivated forage
- agricultural by-products, and
- industrial-by-products

2.4. Breeds and Breed Selection

The productivity of dairy cows depends on the type of breeds. Breeds of milk cattle could either be indigenous, exotic or cross breeding.
Naturally the indigenous breeds are less productive when compared with the other types. However, they have their own merits. Thus, indigenous cows are characterized by their high adaptability to harsh environment, high resistant to diseases, less feed intake, but low in production. That is why they are assumed to be **'less input and less output'**. In contrast to this assumption the exotic breeds are less resistant, high feed intake, less adaptability, but high production *(Richard, 2007).*

Although an exhaustive study has not yet been undertaken, milk production from indigenous cows is generally considered low. Studies indicate that lactation yield on average does not exceed 500 liters and most lactation periods are shorter than 150 days. This trend among the exotic/upgraded breeds is far improved, in which a cow is milked an average of 2500 liters in a lactation period of 270- 300 days. However, the butter content of the indigenous cows is relatively high. The indigenous cows have been selected over millennia for adaptive rather than for productive traits. Nevertheless, there are indigenous genotypes/breeds that produce comparatively high milk yield like the ***Begaits*** in Tigray (Ibid).

The estimated number of indigenous cows in Ethiopia is about 9 million. These animals are in the hands of the smallholders and are managed in traditional ways. An estimated number of 30,000 crossbreed/upgraded cows are used for milk production under relatively improved management conditions. These cows are found mainly in urban and peri-urban areas of the country *(Auli, 2007).*

Currently the FDRE government is approaching alternative policy potions on how to boost milk production. One of the main avenues for sustainable increase in milk production is to embark on a selection and breeding program among the adapted local cattle. The other alternative pursued is to increase milk productivity through crossbreeding the indigenous cows with exotic dairy breeds. This is considered as one of the best alternative in high potential areas where market opportunities exist. In good management it is worth to use cows with 75% exotic blood (or even higher), but in poor management 50% exotic blood is recommended *(M.Heinonen, 2008)*

2.5. Problems and Prospects

2.5.1. Problems / Constraints

The factors that limit milk production are known as constraints. Dairy production in the urban centers is constrained by a number of factors: social, economic and cultural aspects, unavailability of enough animals' feed resources in terms of quality and quantity, disease and low level of veterinary services, unproductive yet environmentally adaptable breeds, high cost of inputs, frequent drought, poor livestock husbandry especially among the smallholder *(Puck Bonnier,2004)*. Dairy marketing is a key constraint to dairy development throughout Sub-Saharan Africa. Marketing problems must be addressed if dairying is to realize its full potential to provide food and stimulate broad based agriculture and economic development. Because dairy development is sources of employment since it is labor intensive and associated with large incomes and price elasticity of demand. There is also risk of price decrease to suppliers' related to dairy imports and food aid, and seasonal fall in demand due to cultural conditions. Adulteration is also believed to be a problem especially among the smallholders**.** Therefore, to increase milk productivity, it is necessary to remove the limiting factors, and in turn exploit opportunities that could improve productivity of milk *(Ray F.Brokken, 2006)*

2.5.2 Prospects /Opportunities

The future prospects of dairying seem to be bright because the constraints so far indicated above are noticed and the government is attempting them remedy through policies and strategies. Thus, dairy farmers are on the way to getting access to services and inputs that could help promote dairy production and productivity. This mainly includes feed and feeding, breeding services, credit, extension, training, veterinary services, and appropriate marketing system that addresses consumers' demands etc*. (Amha, 2008).*

Since dairying is labor intensive it promotes the motto of the government policy in creating employment opportunity at household level. Thus, it improves employment, income and nutrition values of the family of the producers and the other demanders/ consumers. The dairy industry would address and serve as one of the major instruments of the government's policy in achieving food security. This in turn promotes dairy production due to the attention given by the government.

The development of infrastructure like transportation would help change the traditional thinking of 'fresh milk not for sale' other than exclusively intended for home consumption among the rural population. On the other side when the rural farmers expose themselves to the market, their income will increase and be in a position to buy non-milk food types in exchange, and thereby improve their living standard *(Ayele lema, 2006).*

Since the country is an agrarian economy, dairying is much expected to be one of the major targets of the prospective agro-processing industries in the country. The forward and backward linkages with other agro-processing industries and crop production would potentially be strengthened.

2.6. Livestock Sources of Ethiopia and its Economic Importance

The major resource bases of the Ethiopian economy are population, land, and livestock, natural resources in the presence of diverse physical features and a variety of agro-ecological zones. However, much of its potential resource base has not yet been utilized to its optimum level. Similarly, the livestock contribution to the economy is limited and in proportionate to the presence of the largest livestock populations in Africa. According to the 2006/07 statistical figures of the Ministry of Economic Development and Cooperation

(MEDaC), the livestock population of Ethiopia incorporates: 30 million cattle, 24 million sheep, 18 million goats, 1 million camels and 56 million poultry. It is indicated below in the table including that of Tigray.

Table: 2.2. Estimated size of livestock population of Ethiopia / Tigray, 2006 /07

Types of animals	Livestock population		% in Tigray
	Ethiopia	Tigray	
Cattle	3o million	2.15 million	7.16
Sheep	24 million	2.6 million	10.83
Goats	18 million	3 million	16.88
Camels	1 million	370,000	37
Poultry	56 million	3 million	5.04
Bee colonies	7 million	130, 710	1.86
Equines	7 million	360,000	5.14

Source: Regional Bureau of Agriculture (2008)

The importance of livestock to the Ethiopian economy could be assessed both at the micro and macro levels. With regard to the micro level the contribution of livestock is paramount importance, in different respective geographical regions of the country. In the predominantly nomadic and semi-nomadic areas, livestock are the main sources of livelihood of the pastoralists, their major source being food (milk, meat etc.), store of wealth and source of income. In the mixed farming systems the contribution of livestock is extended to means of transportation, ploughing and their dung serve as major source of fertilizer (Haile Hagos, 2007).

The development and expansion of urban centers have also expanded the economic importance of livestock to the rural economy being market bases for livestock products including that of dairy products. As demand escalates in the urban areas the cash income of the rural economy increased in return. Macro-level importance of livestock includes its contribution to the gross domestic product, to export earnings and as source of government revenue.

2.7. Supply and consumption of Milk

Consumers in Ethiopia use milk and milk products from cows, sheep, goats and camels. Cow milk is the most widely used all over the country, especially in the urban centers. Camel and goat milk is consumed more in the lowlands. Production is dominated by smallholder peasants while profit oriented farms are located in intra urban and peri-urban areas of big towns.

The dairy industry includes the production, processing and marketing of milk and milk products. In the vicinity of cities or large towns the milk producer has a ready market for his liquid milk. However, in rural areas outlets for liquid milk are limited due to the fact that the nearest market is beyond the limit of product durability, since milk is a perishable product. In connection to this reality, a study in Western Tigray by the Regional Bureau of Agriculture (2006) has shown that surprisingly about 45,000 liters of fresh milk/per-day is remained to be wastage.

In summary our level of milk consumption is low as compared to other countries. For comparison, the average consumption for the whole Africa and other neighboring countries can be considered in the table below

Table: 2.3. Supply per capita comparison of milk, 2006.

Country	Kg / capita,	Annual growth
Africa	37.2	-1.38
Ethiopia	**19**	**-2.87**
Kenya	78.5	-2.67
Sudan	161.4	-0.72

Source: FAO Database, 2006

Thus, there is a wide gap in consumption between Ethiopia and other African countries. If we consider all African average and keeping import at the present level, we need to produce additional 18.2 kg per capita.

2.8. Factors Determining Aggregate Demand for Dairy Production in Urban Centers

2.8.1 Demographic Trends:-

For the past three decades, much of the developing world has witnessed unprecedented levels of urbanization with more and more people flocking to urban centers.

Urbanization is the process of concentration of people in areas whose functions are nonagricultural, except very limited aspects of farming activities such as gardening and milk production. It refers to the status of urban settlements, size of population, and function of people. All areas with a population of 2000 and above are classified as urban centers *(Kebede Mammo, 2006).* According to 2008/09 population census, the total population of Ethiopia was 79,368,000 of these 20% were living in urban areas and will be projected to be reached 26% by 2015.

The following table indicates data on the projected urban population of Ethiopia from (1995-2020.)

Table: 2.4.Urban population projection for Ethiopia (1995-2020)

No.	Year	Total pop.(000's)	Urban pop.(000's)	% of urban population
1	1995	56677.1	8681.0	15.3
2	2000	66755.8	11753.6	17.6
3	2005	79368.5	15952.8	20.1
4	2010	94246.0	21400.4	22.7
5	2015	111583.8	20069.2	26.5
6	2020	131485.2	39530.1	30.6

Source: CSA, Statistical abstract, 1997. Addis Ababa, Ethiopia.

The consequence of rapid population growth in the urban centers obviously calls for increasing supply of food like milk and milk products, of course, among all other multifaceted services. In connection to such a trend of population growth in the urban centers, it is assumed that the projected demand-supply variance for fresh milk to be about 2.74 billion liters per annum. In satisfying this increasing demand, at least 4% annual increase in milk production will be required otherwise the government would continue to import milk and milk products, *(Auli, 2007).* As an indication according to a dairy market survey for Addis Ababa, there was a shortage of 43,000 liters per day (Ministry of Agriculture, 2006).To overcome this demand shortage the country imports in different forms either through food aid or purchase. According to the Ethiopian Customs Authority's annual trade statistics, Ethiopia imported 717 tones of milk value at Birr 18.4 million and a total of 2053 tones valued Birr 23.6million including other milk products in 1998 *(Ray.F.2006).*

Kebede Mammo (2006), has indicated that the population of **Mekelle** in between the years 1850 and 1899 was estimated to be 15,000. Surprisingly in 2007 the population of the city reached 236,000. This could make quality service provisions difficult unless systematically and timely managed. During much of its history, Ethiopia lacked peace and order, and

much of the urban history was characterized by the absence of fixed urban centers. These circumstances have created unfavorable conditions for urban development in the country until it was revived at the beginning of the twentieth century.

2.8.2 Changes in incomes:-

Changes in incomes can be expected to cause significant shifts in the nature, scale and location of demand for milk. The proportion of total household expenditure spent on food declines as income increases, but to shift to milk and milk products consumption increases. In fact, income increasing may not necessarily increased expenditure on dairy products.

2.8.3 Prices:-

Prices reflect underlying market forces but also qualitative differences in consumption and in policy intervention, the effect, which are hard to quantify. Consumer prices and international prices could be taken into account in this regard.

2.8.4. Season:-

The demand for milk may vary with change of seasons among different socio-cultural features and beliefs. Fasting among the orthodox Christians, for instance, causes a decline in demand for milk and milk products in Ethiopia.

2.9. Marketing

Marketing involves all activities involved in the production, flow of goods and services from point of production to consumers. In other words Marketing includes all activities of exchange conducted by producers and middlemen in commerce for the purpose of satisfying consumer demand. Marketing is defined as the set of human activities directed at facilitating and consummating exchanges. All business activities facilitating the exchange are included in marketing (Philip kotler, 2005).

Dairy Marketing Systems in Ethiopia

As is common in other African countries (e.g., Kenya and Uganda), dairy products in Ethiopia are channeled to consumers through both formal and informal dairy marketing

systems. Until 1991, the formal market of cold chain, pasteurized milk was exclusively dominated by the Dairy Development Enterprise (DDE) which supplied 12 percent of the total fresh milk in the Addis Ababa area (Holloway et al. 2005). Recently, however, private businesses have begun collecting, processing, packing and distributing milk and other dairy products. Still, the proportion of total production being marketed through the formal markets remains small (Muriuki et al, 2006). Formal milk markets are particularly limited to peri-urban areas. However, unlike the early phases, the formal market appears to be expanding during the last decade with the private sector entering the dairy processing industry.

2.10. Cost-Benefit and Break-Even Analysis

The term cost generally refers to the outlay of funds for product or productive services. Several kinds of costs are involved even in the most simple production processes. Two major categories of cost are fixed and variable cost (Heady, 2004).

Variable cost refers to those outlays that are a function of output in the production period. it is the cost which directly depends on the volume of output or service. Variable costs increase but not necessarily in the same proportion as the output increase. The degree of proportionality between the variable cost and output depends upon the utilization of fixed facilities and resources during the process of production. Its proportion first declines, becomes constant and starts rising. It includes feed cost, labor cost, veterinary cost, transportation cost, interest on working capital and miscellaneous cost, etc.

Fixed cost refers to those cost do not vary with (are not a function of) output. This is the part of the total cost of the farm, which does not vary with output. If the period under consideration is long enough to allow the necessary adjustments in the capacity of the farm, the fixed cost no longer remain fixed. When the output goes up the fixed cost per unit of output comes down as the total fixed cost is then divided between greater numbers of units of output. The fixed cost includes depreciation of building such as cowshed, bull and calves house, store, offices, depreciation of cows, depreciation of equipments and interest on fixed capital.

Efficiency is the ratio of output to input. The concept is important as it shows how profitable the farm is. There are several measures to explain the efficiency of a farm. In particular situation, due importance is given to a particular measure, depending up on the objective behind its measurement. For instance, different measures should be adapted for indicating the volume or the size of business, the aggregate earning of the particular factor or the business as a whole, and the returns per units of a particular factor. Further the efficiency of a farm can be judged from costs or returns and or both. The point is that no single efficiency measure is adequate enough to give a true picture of performance of a farm business. Cost-benefit ratio is a powerful tool to measure the profitability of farms and make comparison between farms and different size groups of farms. The cost-benefit (C:B) ratio compares the variable cost to gross return to estimate the gross margin as well as compares the gross return to total production cost to estimate the overall profitability of the farms.

Break-even analysis is a powerful tool in enterprise analysis. The break-even output can be computed for yield and sale price by comparing total revenue to total production. The analysis helps to know the profit and loss areas of its operation on the profit and non-profitable ranges of production. Sangu (2004), Bordoloi et al. (2006) and Chand et al. (2007) calculated the break-even level of milk output per animal per year for cross breed and local breed cows, respectively and compared efficiency differences among breeds and size categories using the following formula;

$$\text{Break even level of output} = \frac{\text{Total fixed cost per animal}}{\text{Price per liter of milk} - \text{Variable cost per liter of milk}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1$$

2.11. Theory of Production Function

Production is an activity that transforms inputs into output. This transformation process can be of three dimensions: change in form, change in space and change in time. Thus, production is a process of generating output and its distribution as well as storage of tangible goods. A farm production behavior is fundamentally determined by the state of technology. Existing technology sets upper limit for the production of the farm, irrespective of the nature of output, size of the firm or the kind of management (Gujarati, 2003). There are wide varieties of inputs used by a farm, like various raw materials, labor

service of different kinds, machine tools, and building etc. Inputs are broadly divided into two broad categories as fixed and variable. A fixed input is the one whose quantity cannot be varied during the period under consideration. All inputs whose quantity can be changed during the period under consideration are known as variable inputs.

Production function is the technical physical relationship between the quantity of the firm's resource inputs and the quantities of output of goods or services produced per unit of time.

It refers to the relationship between the inputs of factor services and the output of product. Output is a function of or is dependent on the input of resource services (Heady, 1952, pp 29-30). Also, expresses the relation between output of a good and the input used in its production. To be specific the production function is a table, a graph or an equation specifying output rate from a given amount of input used.

The production function may be expressed as an algebraic equation of the form Y=F (X) which means that Y is a function of X. This equation means that for each value of X there exist a corresponding value of Y. Product is never a function of (produced by) a single factor and most commonly does not result from a single variable factor, all other factors remaining fixed. Thus to show the simultaneous effect of these combination, one has to use single equation that shows the relationship of Y to a combination of inputs used (X). Most of production function research, whether it has involved plants, animals, firms or enterprises with in a firm, has been based on single equation model. To a large extent, the single equation approach has been used because of its computational simplicity (Heady and Dillon, 2001). Thus, a production function may be expressed in the general form as,

$$Y= f(X_1, X_2, X_3, X_4/ X_i \ldots X_n, E_i) = \text{----------} \quad (2)$$

Where,

Y = Single commodity produced.

Xs = Factors /input of production.

Ei = Error terms

In this relationship the perpendicular bar indicates that all factors to the left of the bar are variable while all factors to the right of the bar are fixed in quantity (Heady, 1952).

2.11.1. Specification of the model

A model is simply a set of mathematical equations. If the model has only one equation it is called a single equation model, where as if it has more than one equation, it is known as a multiple equation model. In formulating an economic model of the production process, the researcher faces three main tasks. First decide whether a single equation or a system of equations is appropriate. Second to choose set of variables those are relevant to the model. Lastly, hypotheses have to be made, and tested, as to the most appropriate algebraic form of the equation(s).

The researcher's aim is to specify a suitable economic model, which expresses the relationship in mathematical form to explore empirically the real production process. The relationships between economic variables are generally inexact. To allow for the inexact relationships between economic variables, modifying the mathematical model to econometric model is necessary as shown below (Gujarati, 2003).

$$Y = \beta_0 + \beta iXi + u \text{---------- (3)}$$

Where u, known as the disturbance, or error term, is a random (stochastic) variable that has well defined probabilistic properties and β_0 and βi are intercept and slope (coefficients) of the relationship. The econometric model hypothesizes that the dependent variable Y is linearly related to the explanatory variable X, but that the relationship between the two is not exact; it is subjected to individual variation. The variable appearing on the left side of the equality sign is called the dependent variable and the variable(s) on the right side are called the independent or explanatory variable(s).

The coefficients of the economic model may be estimated by using the single equation estimation or simultaneous equation techniques (Sharma and Singh, 2003). Numerous research studies in agriculture revolve around production functions with a single resource or treatment applied at different levels (Heady and Dillon, 2001). The numerical estimates of the parameters give empirical content to the function. The statistical technique of regression analysis is the main tool used to obtain the estimates.

2.11.2. Selection of appropriate algebraic forms of production function

In choosing algebraic form for the production function to be estimated, the researcher should take into consideration the logic behind the production process. Also, the selected function must be computationally manageable both for estimation and testing. Still, there will often be no strong guides as to what algebraic form might be appropriate. Numerous algebraic forms can be used in deriving production function equation. No single form can be used to characterize agricultural production under all environmental conditions. The algebraic form of the function and the magnitudes of its coefficients will vary with soil, climate type and variety of crops or livestock, resources being used, state of mechanization, magnitude of other inputs in fixed quantity for the firm etc. Hence, an algebraic form of the production function, which appears or known to be consistent with the phenomena under investigation, is selected. Guides on appropriate algebraic forms may come from previous investigations and the theories of the sciences involved (Heady and Dillon, 2006).

Comparing linear and log-linear regression model

The theory is often not robust enough to suggest whether one should fit the linear model or the log-linear model or some kind of polynomial model. One guiding principle in choosing among competing model is to plot the data. If the scatter diagram showed that the relationship between dependent and independent variables looks reasonably linear (i.e. straight line), the linear specification might be appropriate. But if the scatter diagram shows a non-linear relationship, plot the log of Y against the log of X, if this plot shows an approximately linear relationship, a log- linear model may be appropriate. By definition, r^2 measures the proportion of the variation in the dependent variable explained by the explanatory variable(s). Why not choose the model on the basis of r^2, that is, choose the model that gives the highest r^2. Although intuitively appealing, this criterion has its own problems. First as noted to compare the r^2 values of two models, the dependent variable must be in the same form. In linear model it is Yi and log-linear in lnYi. Therefore, the r^2 of the two models are not directly comparable. In linear model r^2 measures the proportion of the variation in Y explained by Xi, where as, in the log linear model it measures the

proportion of the variation in log of Y explained by the log of X. Now the variations in log of Y are conceptually different. The variation in log of a number measures the relative or

proportional change (or percentage change if multiplied by 100) and the variation in the linear form of a number measures absolute change. Even if the dependent variable in the two models is the same so that r^2 values can be directly compared, one is well advised against choosing a model on the basis of a high r^2 values criterion. This is because r^2 can always be increased by adding more explanatory variables to the model. Rather than emphasizing the r^2 value of a model, the researcher should consider factors such as the relevance of the explanatory variables included in the model, the expected signs of the coefficients of the explanatory variables, their statistical significance, and certain measures like the elasticity coefficient. These should be the guiding principles in choosing between two completing models. Although, both slope coefficients are statically significant, we can not compare directly, for in linear variable model it measures the absolute rate of change in Yi for a unit change in Xi, where as in the log-linear model it measures elasticity- the percentage change in Yi for a percentage change in Xi (Gujarati, 2003).

Multiple variable log-linear regression models

The two-variable log-linear model can be easily extended to a model containing more than one explanatory variable, which can be expressed as follows;

$$\ln Y_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \text{---} + \beta n \ln Xni \ldots\ldots\ldots\ldots(4)$$

In this model the partial regression coefficient β_1, β_2 --- βn measures the elasticity of Y with respect to the corresponding Xi holding the influence of the remaining explanatory variables constant. In other words; it measures the percentage change in Yi for a percentage change in Xi, holding the influence of the remaining explanatory variable constant. In short, in multiple log-linear models, each partial slope coefficient measures the partial elasticity of the dependent variable with respect to the explanatory variable in question, holding all other variables constant. If we add elasticity coefficients, we obtain an economically important index called the return to scale parameter, which gives the response of the dependent variable to a proportional change in the magnitude of the independent variable. If the sum of the elasticity coefficient is one we have a constant return to scale; means that doubling the amount of the independent variables simultaneously, doubles the result of dependent variable; if it is greater than one, we have increasing return to scale, means double the dependent variable amount simultaneously

more than doubles the dependent amount; if it is less than one, we have decreasing returns to scale i.e., doubling the quantity of independent variable gives less than double the dependent variable.

Cobb- Douglas production function

The Cobb-Douglas function is a power function, which can be converted into a linear form by expressing it in logarithmic form. The model with the stochastic error term is expressed as;

$Yi = \beta 0\ X_{1i}^{\beta 1}\ X_{2i}^{\beta 2}\ \ldots X_{ni}^{\beta n} e^{ui}$ …….. (5)

Where,

Y= output

β_0 = the intercept of the relationship (constant)

β_1 …βn are the power corresponding to the respective inputs (Xi…Xn)

X_{1i}…Xni are inputs (explanatory variables)

Ui = Stochastic disturbance term

e = base of natural logarithm

Taking the natural logarithm of each side of the above equation gives the linear expression as follows.

$\ln Yi = \ln \beta o + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \ldots BnXn + Ui$…… (6)

Here the constants β_1 through β_n in Equation 4 became the partial regression coefficients of the multiple linear relationship of Equation 5. Thus with appropriate transformation the non-linear relationships can be converted into a linear form so that it is possible to work within the framework of the classical log-linear regression model (Gujarati, 2003).

The Cobb-Douglas production function has the following properties

1. Each partial regression coefficients β1 through βn is the (partial) elasticity of output with respect to the corresponding input Xni, that is, it measures the percentage change in the output for a unit percent change in the Xni input, holding the others inputs constant.

2. The sum β1 through βn (i.e. $\sum_{n-1}^{n} \beta n$) gives information about the returns to scale, that is, the response of output to a proportionate change in the inputs. If the sum is 1, then there is a constant return to scales that is, doubling the inputs will double the output, tripling the inputs will triple the output, and so on. If the sum is less than 1, there is decreasing returns to scale-doubling the inputs will give less than double of the output. Finally if the sum is greater than 1, there are increasing returns to scale- doubling the inputs will give more than double of the output.

3. In a Cobb- Douglas production function, if one of the inputs is zero, the output is also zero, implying that all the inputs considered in the function are necessary for the production process to take place.

The Cobb- Douglas production function is most popular in empirical research because of the following;

1. The Cobb-Douglas function is convenient. Since partial regression coefficients are partial elasticity coefficients and are pure number (i.e., independent of units of measurement) they can be easily used to compare results of different samples having varied units of measurement.

2. This function exhibits the essential non-linear ties of a production process and also has the benefit of the simplification of calculations by transforming the function into a linear form with the help of logarithms. The log-linear function becomes linear in its parameters, which is quite useful to a managerial economist for his analysis.

3. In addition to being elastic ties, the parameters of a Cobb-Douglas function show the returns to scale in the production process and shares of inputs from output.

4. This function can be used to investigate the nature of long run production function is increasing, constant or decreasing returns to scale.

In general, the Cobb-Douglas production function provides a compromise among adequate fit of data, computational simplicity and sufficient degrees of freedom for statistical testing. In other words, the Cobb-Douglas production function is a relatively efficient user of degree of freedom. Such efficiency is important where research resources are limited and collection of farm-firm data is expensive (Heady and Dillon, 2006).

In summary the Cobb-Douglas production function model has the following desirable

Features

1. It is log-linear and considers the relationship of each input with output taken not individually but simultaneously with all other inputs.

2. Has been used widely because of its convenience in interpreting regression coefficients as elasticity of production.

3. Estimation of parameters involves fewer degrees of freedom than other algebraic forms, which allows for increasing return to scale? The sum of these production elastic ties indicates the nature of return to scale.

In addition, this function is preferred because of theoretical fitness to agricultural data, i.e. when it is written in form of the logarithms it will be linear and one can take the advantages of the many simplifications in the process of statistical estimation that are possible in the case of linear relationships. This function has greatest use in reflecting marginal resource productivity at mean level of inputs. It also allows the assessment of marginal value productivity if it is constant, increasing or decreasing for a given average level of inputs.

2.11.3. Method of fitting the Cobb-Douglas production model to a set of input-output data and choice of input variables

The parameters of the Cobb-Douglas model (Equation 5) can be fitted to a set of input-output data by using multiple regression analysis. Accordingly the value of the output (Yi variable) and inputs (Xi…Xn) are converted in to log forms and using the ordinary least square fitting procedures, the constants of the equation (ln βo and the partial regression coefficients) can be estimated. The least square procedure in context of multiple regression analysis is a procedure of selecting a unique multiple regression equation with regression constants that gives the smallest value of residual sum of squares, i.e., $(Yi-\hat{Y}i)^2$ where, Yi observed values of the output variables and $\hat{Y}i$ are estimated value using the equation.

Hence the least square procedure simply means for a given multiple linear regression equation to be the best, the sum of squared deviation between the observed values of Y and the corresponding estimated values from the equation should be minimum (Zar, 2004). The computational steps normally performed by using computer programs as most statistical packages have the capability to perform multiple regression analysis (example, SAS, SPSS etc).

Prior to fitting the regression equation that best describes a set of input-output data, it is necessary to assess the presence of multi-co linearity among the input variables (Xi). Multi-co linearity is said to exist when some independent variables happen to correlate with each other. If two independent variables X1 and X2 substantially correlate with each other, the partial regression coefficients b1 and b2 do not reflect the true dependence of Y on X1 and X2. As a result upon identifying correlation between two independent variables, then the X variable considered less important to the model is excluded from the analysis.

Multi co linearity test can be done, by performing multiple correlation analysis among the input variables. Anyone of the standard statistical packages can produce the partial correlation coefficient matrix and accordingly the variables happen to correlate with each other can be easily identified. Exclusion of the input variable considered less important to the final production function model requires good knowledge about the relative importance of the input variables in affecting the output or the production process, a procedure commonly known as choosing important repressor variables for the predictive model. After

performing the multi co linearity test, then only those input variables that do not inter correlate with each other are considered to develop the multiple regression equation. As a matter of fact, not all the repressor (input) variables are important in affecting the production process. It is possible that some of the considered repressors may not significantly affect the output or the "y" variable. As a result it is necessary to determine which of the considered input variables have significant effect on y variables and thus be included in the final production function equation.

2.12. Experiences on Dairy Development and Marketing in Saharan Africa.

Sub-Saharan African Countries are predominantly agrarian economy, among which dairying as a component of livestock production is an important economic activity. Milk production accounts for about 50% of the livestock food products since the 1970s. (Mbogoh, 2006). Nevertheless, the dairy sub-sector has performed badly over the last decades. Thus, the expansion of milk output in Sub-Saharan Africa has not kept pace with the increase in human populations, the rates of increase of which are 1.4% and 2.9% respectively. Demand, especially in the urban centers had tremendously increased. This in turn, as explained earlier, leads to the rise in dairy imports to the region either in commercial terms or as food aid in which both respectively have negative connotations towards foreign exchange and sense of dependency on food aid *(Mbogoh et al, 2006).*

Such unsatisfactory situation obviously needs an intensifying effort so as to bring about self- sufficiency provided that the region is potentially rich. Most experiences of economic strategies of the developing countries show that they are not complete by themselves. The intensification of milk production also requires an appropriate and targetful marketing system to each respective types and levels of dairy production systems. This is ensuring policy goals of creating sufficient outlets for increased output of milk products and the marketing system provides the right incentives to the producers so that they are able to supply the desired service to the consumers at the prices they are willing to pay. These prepare a prospective ground for a marketing system to be efficient; so as to achieve the trend of increased dairy production, and thereby coping the ever-growing demand, particularly in the urban areas.

Efficiency of alternative dairy marketing system is an important policy issue in livestock development. However, many dairy development schemes in Sub-Saharan Africa in the past have been accompanied by the establishment of government marketing organizations, without any evaluation as to whether they were appropriate types of marketing systems.

The types of dairy marketing systems can be categorized into two subsystems :(i) a formal (i.e. official or government controlled), (ii) an informal dairy marketing subsystem (i.e. private / cooperative or non-government). Government dairy marketing organizations are large-scale enterprises like that of the Dairy Development Enterprise (DDE) in Addis Ababa which is responsible to collect process and distribute milk and milk products. There are also cases in some countries of the region in which such marketing organizations are expected to distribute production inputs such as animal feedings. However, laissez-faire economists do not support exclusive domination of the market by governments, except acting as facilitators in smoothing the performance of marketing (*Ray.F. 2006).*

On the other side, the informal or traditional marketing systems are said to be free of government interference. Informal marketing systems take the form of either private or cooperatively owned. In fact, in the urban centers of Sub-Saharan Africa like Addis Ababa and Nairobi, government-marketing systems have given the monopoly power, although the informal marketing systems are not completely eliminated. The nongovernmental marketing organizations do not have similar pattern of marketing outlets relative to that of government nature.

From the above discussion one could raise a question as to whether the government marketing system is efficient. On the other hand efficient market could be achieved by either applying both systems(formal and informal) simultaneously. The answer could be synthesized to issue of encouraging the efficient one whatever the marketing system persists. Studies in the issue of as to which category is efficient marketing system indicate controversial results in different countries. In countries like Ethiopia and Madagascar, the informal marketing system is said to be more satisfactory. However, it is the other way round in some other countries of the region. Moreover, in countries like Kenya it does not show a uniform picture. Subsequently researchers rather suggest that further investigation is needed against this background, so as at least design the appropriate dairy marketing system in the region. Attention must be given to the socio

economic and policies of each respective Sub-Saharan African countries. In identifying and realizing the alternative marketing systems, milk marketing systems are getting prior considerations as compared to the other dairy products. The Addis Ababa dairy plant for the DDE has a total processing capacity of 60,000 liters of milk per day. The DDE also operates a small-scale dairy processing unit at Assella in Arsi Rural Development units' farm that can process up to 1000 liters of milk per day

The estimated total milk production in Ethiopia is about 650,000 metric tones per annum. The liquid milk market is believed to account for only about 10% of the total milk production. This market for liquid milk is located mainly in urban centers and towns. The demand for milk consumption in the urban centers, like in Addis Ababa shows an ever-increasing pace parallel to the population growth, mainly as a result of the large concentration of such institutions as schools, college's hospitals, military establishments and industries areas. Hence urban areas often to be under supplied with fresh milk *(Siegfried Debrah and BerhanunAnteneh, 2007).*

In Addis Ababa studies have already identified five marketing systems of fresh milk, *(Mbogoh G. et al, 2006).* namely:

(i) Sales of liquid milk by the actual producers that accounts 70% of the volume of milk.

(ii) Sales by ***kebele*** shops and other DDE designated sales outlets.

(iii) Sales by itinerant trades

(iv) Sales by small private shops and kiosks

(v) Sales by grocer stores and supermarkets

The rural areas, which are beyond 150 kms from Addis Ababa, have limited outlet or little since milk is a perishable item that cannot stay longer time. So milk surplus in the rural areas is converted into butter and ghee, and cheese. Prices for such products change from season to season, in which it becomes to be high during the dry season.

Sales through the informal marketing subsystems may be effected by:

i) Inter-household sales, or farm to house arrangements, and

ii). Trading at local centers.

The Dairy Development Enterprise (DDE) is involved in both the operation and management of the state owned large-scale dairy farms and the collection, processing and distribution of milk. Milk collection is accomplished through about 40 established collection centers, which are located with in about 150 km from Addis Ababa. The share of respective supplies in total deliveries to the DDE comprises:

- State- owned large- scale farms (48%),

-Medium and large- scale private farms (15%),

-Smallholders (34%).

2.13. International Experience-a Success Story On Operation Flood

In the 1960_s India had launched rural development programs under the motto of the "Green Revolution." As part of this rural development scheme, the "White Revolution" had started in July 1970 that gave rise to the famous 'Operation Flood' that boosted milk production. Hence, Operation Flood. It made India self-sufficiency in milk and other dairy products. Besides, India has emerged as the leading milk producing country in the globe in 1998-99. As one of the rural development efforts, Operation Flood is realized to be a significant success story, which was and is appreciated and credited in the eyes of nations of the world. *(Katar Singh, 1986).*

The success of Operation Flood in increasing milk production was also complemented in getting a huge market in Bombay. Even outside India, international food aid organizations like the EEC and WFP have also involved in the Indian dairy market that really broaden market opportunity for the 'flood' of rural produced milk *(Ibid).*

The initial successful dairy cooperative that was replicated to the other regions of the country is called by the name Anand Milk Union Limited (AMUL).

The major objectives of Operation Flood were:

- To produce enough supply of milk at reasonable price to the already created market centers in the cities.
- To enable the producers increase their income and thereby improve their living standard.

- To give special emphasis towards the improvement of dairy farming productivity among the smallholders.
- "To remove dairy cattle from the cities where they represent a growing problem of genetic waste, social cost and public health." This implies "resettlement in rural areas of city-kept cattle."

In achieving the successful and desired outcomes, Operation Flood used the following instruments as summarized by Katar Singh,

1. Major increase in capacity and throughout of dairy processing facilities

2. Competitive transfer of the bulk of the urban markets from the traditional suppliers of raw milk to the modern dairies

3. Resettlement in rural areas of city kept cattle.

4. Development of the basic transportation and storage network to facilitate the regional and seasonal balance of milk supply and demand.

5. Development of milk procurement systems in appropriate rural areas in order to provide raw milk a channel, which was more remunerative than the traditional channel.

6. Improvement in standards of dairy farming by an improved program of feeding and management, animal breeding, veterinary services, feed supplies and management and related extension services by increasing milk yields per animal.

The scope of the dairy cooperatives is not only limited itself in milk production. They carry rather all responsibilities of input provision and services to the members in the dairy farms. This includes, nutritious and balanced cattle feed natural and artificial, artificial insemination, health services, etc. In other words, integrated dairy farming system is the main feature of Operation Flood that deals with all the production, processing and marketing activities. This in turn made the dairy farms as the beneficiaries of backward and forward linkage effects.

2.14. Empirical Studies on Marketing and Milk Production

Empirical studies carried out on milk production indicated variations in the efficiency of inputs used between the traditional (local) and modern (cross) farms as well as among different farm sizes. These studies used production function and cost and return ratio to identify important inputs and differentials in efficiency and productivity between farms in utilization of these inputs.

Several researchers have reported that introduction of cross breed cows enable to achieve rapid break through in milk production, longer lactation length and shorter inter calving period. Moreover, cross breed cows convert feed into milk more efficiently than indigenous zebu breeds. Therefore, the productivity of cross breed cows is often substantially higher than that of indigenous (local) breeds. Moreover, the unit cost of milk production is significantly lower for the cross breed cows than for indigenous cows (Sharma et al, 1995).

In India Sharma and Singh (1993) used the Cobb-Douglas and semi log production functions to study the resource productivity and allocation efficiency in milk production and to assess the relationship between milk production and various factors influencing it. They assessed the effects of value of green fodder, value of dry fodder, value of concentrate, human labor cost, order of lactation, stage of lactation and miscellaneous expenditure variables in different seasons of the year and between farms with and without crossbreed (local buffaloes). The study revealed that, concentrates were the most important factors in milk production.

Moreover, Deepak et al. (2005) employed Cobb-Douglas production function to study input-output relationship in the resource use efficiency for milk production of different breeds of cows. They studied the relationship between value of milk and explanatory variable such as stage of lactation, value of cow and expenditure on green fodder, on dry fodder, on concentrate and on labor. The study revealed that, expenditure on concentrate was the single most significant factor affecting return from milk.

Sadiq et al. (2006) indicated that animal units, feed and labor have significant positive contribution to livestock production, while medical cost affected the enterprise negatively.

Moreover, the order of importance of the factors in milk production differed between traditional and modern farms as identified based on cost ratio of the inputs (factors) used for milk production. The contribution of different inputs and total milk production cost ratio between and with in different farm sizes in local and cross breed dairy farms were also empirically studied.

Cost ratio was estimated by Sayeed et al. (2005) in Bangladesh through a study on 132 households classified based on land holding into small (up to 1.00 hectare), medium (1.01 to 2.00 hectares) and large farms (above 2.00 hectares). The group aggregate result revealed that, labor charge had the major share 55.87%, for the native cows followed by dry fodder (17.9%), concentrates (13%) and green fodder (8.2%), miscellaneous expenses (2%). For crossbreed cow, labor cost accounts for 41.79% followed by concentrates (20.4%), dry fodder (12.1%), green fodder, (11.2%), fixed cost (3.9%), miscellaneous, (3%) and veterinary charges (2.3%).

The investment pattern on fixed assets in rural dairy farming was studied by Kumar and Prabaharan (2004) in Tamil Nadu, India, and the result revealed that the overall total investment per cow was 4517.73 Rupees of which 87.87% was on animals, 8.6% on buildings and 3.46% on dairy equipments and machinery. Where as, for cross breed cow the investment was 7437.56 Rupees of which 90.47% on animals, 7.08% on dairy buildings and 2.45% on dairy equipment and machinery. The total cost was the highest in small farms while it was lowest in medium farms for local breed cows owning farms. Regarding crossbreed cows the highest cost was for large farms and the lowest is for small farms. Also, the study indicated that, the highest labor charge was observed in small farms of both local and cross breed cows as compared to medium and large farms because small farms did not employ their surplus labor elsewhere, they remained engaged with dairy rearing activities.

In village and town of western ultarpradash, India, the total cost incurred on cross breed cows was more than that on local cows. Along with this, total maintenance cost is higher for cross breed than for local breed cows. The production cost per kilogram milk was 3.88 and 3.48 Rupees for cross breed and local breed, respectively. And maintenance cost was 2839.66 and 1317.45 Rupees per cow per year .The major share of cost was for concentrate feeds, followed by green fodder, labor and dry fodder. The return per kg of milk was

higher for cross breed cows than local breed cows. It was 5.65 and 5.37 Rupees, respectively (Sangu, 2004).

In Bangladesh, a study was conducted by Alam et al. (2007) on 25 randomly selected farms classified as small farms (1-5 cattle), medium farms (6-10 cattle) and large farms (11-20) of which each group had at least one cross breed. The aggregated result of the study revealed that, concentrate feeds took the higher share (35.1%) followed by labor cost (23.64%) out of the total cost. The study also revealed that average total cost was higher in larger farms followed by medium and small farms. Regarding fixed cost depreciation cost is the largest share, depreciation cost account to 12.16%, 11.17% and 9.56% of total cost for large, medium and small farms, respectively.

The results of some empirical studies which used the above mentioned measures of efficiencies have indicated differences in profitability and performance among and with in traditional (local) and modern (cross) dairy farms. According to Sangu (2004), rate of return in town per Rupee invested over variable cost and total cost was high for cross breed cows than local cows. Also farms owning cross breed cows were more profitable as their actual production level was higher than break even level allowing them to generate more profit. The actual production was 2280 and 1260 kg and the break-even level was 940 and 576 kg for cross breed cows and local breed cows, respectively.

Sayeed et al. (2005) used gross margin and found out that, the net margin per liter was-1.18 Taka (Bangladesh currency) for small, 0.43 Taka for medium and 0.71 Taka for large size farms of the local cows. For cross breed, per liter net return was 2.11, 3.77 and 4.11 Taka for small, medium and large farms, respectively. The study also revealed that, the cost-benefit ratio per liter was 1:0.93 for small, 1:1.03 for medium and 1:1.04 for large farms owning native cows. It was 1:1.19, 1:1.37 and 1:1.47, respectively, for small, medium and large farms owned crossbreed cows. The over all aggregate net margin and cost-benefit ratio per liter result was 1:0.52 and 1:1.04 for the native and 1:1.33 and 1:1.34 for the cross breed, respectively. In local breed farms for one Taka total cost incurred earned 0.52 Taka margin over and for one Taka cost incurred earned 1.04 Taka benefit over while in cross breed cow farms for one Taka total cost incurred earned 1.33 Taka margin over and for one Taka cost incurred obtained 1.34 Taka benefit over the cost. These

results indicated that, large farms were profitable than small and medium farms owned for local breed and cross breed cows.

Alam et al. (2007) found that in Bangladesh gross margin was higher for large dairy farms (30241 Taka), followed by medium dairy farms (11905 Taka) and small dairy farms (5738 Taka). The study also revealed that cost-benefit ratio of 1:1.02, 1:1.04 and 1:1.05 for small, medium and large dairy farm respectively. These results indicated that all farms were profitable but large farms were more profitable than others.

Chand et al. (2005) found that in India gross returns, net cost and net returns were largest for small herd dairy farm followed by medium and large herd size dairy farms. The result revealed that the share of gross return, net cost and net return from the total were 70%, 53% and 18% on small, 64%, 51% and 13% on medium and 62%, 50% and 12% on large farm owners in Rupee per animal per day, respectively.

Similarly Mian et al. (2005) assessed the costs, returns and profitability of dairy farming in Bangladesh on small, medium and large dairy farms. They found the total cost of dairy farming was the highest for medium farms followed by large and small farms, and the highest gross return was found for small farms, followed by medium and large farms. The study also indicated that inadequate supply of feed on fodder, unavailability of grazing land and inadequate veterinary services were among the constraints.

Saadallah (2005) reported that dairy farming with both local and cross breed cows were highly profitable in Bangladesh. The profitability of cross breed cows was however, much higher than that of local cows. The result indicated that, the crossbreed cows had higher gross margin than local breeds at the second and third lactations.

Aitawade et al. (2005) conducted study in India, and concluded that cross breed cows were highly profitable and net profit per liter of milk was highest in the farm with medium size land holdings (2-8 hectares of cultivated land) compared to those who owned larger land.

A study done by Sadiq et al. (2006) in India found that, milk contributed about 72% to the live-stock output both on large and medium farm categories while it contributed about 77% on small farm. On average, large farms got 67632 Rupee, while medium and small farms earned 39900 and 32324 Rupee/ year, respectively. Appreciation of calves was the second,

contributing 22%, 23%, and 19% on large, medium and small farms, respectively. Labor and fodder were the main cost items in livestock production contributing to 70-80% of the total cost. Fodder (green as well as dry) accounted for 15% of total cost on different farm sizes.

Anthony et al. (2006) carried out a comparison of urban and peri-urban dairying in Hawassa. He compared Hawassa town with its peri urban areas. In the study 124 farms were covered, out of which 60 farms were from urban and 64 from peri-urban areas. The farms were stratified into small (1-3 cattle), medium (4-9 cattle) and large (greater than 9 cattle). The result revealed that, urban producer spent on average a total of Birr 689.59 and Birr 100.67 per cow per month on feed for cross breed and local cows, respectively. While their peri-urban counterparts spent Birr 97.06 and 15.57 for cow per month for cross breed and local breed, respectively. The yield per lactation in the urban area was 1489.6 liters per local cow and 3949.6 liters for cross breed cow. In the peri-urban area, per lactation yield were 444.4 liters and 2596.32 liters, respectively for local and cross breed cows. The urban producer sold 80% of the total milk produced, while the peri-urban sold only 35%.

Reijo (2007) employed gross margin to evaluate the profitability of cross breeds and local breed in western Shewa zone Selalie area. He documented that, cross breed cows gave a gross margin of 937 Birr/cow/year. The gross margin obtained was seven fold of the gross margin that could be obtained from a local cow. He indicated that the result observed was in agreement with a similar study conducted by Small Scale Dairy Development Program (SDDP) in the central highland of Ethiopia in 2005, that the gross margin was 868 Birr/cow/year for crossbreed cow.

CHAPTER – III

MATERIALS AND METHODS

3.1. Description of the Study Area

3.1.1. Location and Aerial Extent

Tigray is located in the north of the country; situated at 12^0 15'N and 14^0 57'N latitudes36^0 27' E and 39^0 59' E longitude; the region covers an approximate surface area of 53 638 square km. Altitude varies from about 500 meters in the northeast to almost 4000 meters above sea level(m.a.s.l.) in the southwest. In the east of Tigray, there is an escarpment that drops from 2000 m.a.s.l steeply to 500 m.a.s.l. As one moves west of the escarpment the area is largely made of mountainous plateaus. The altitude of this area ranges from 1500–3000 m.a.s.l, which again drops in elevation, as one moves further west, to about 500 m.a.s.l. Tigray Shares common borders with Eritrea on the North and Sudan on the west and with regions of Amhara and Afar on the south and east respectively

The Climate varies from “kola” (semi arid) 49%, "Woina dega" (warm temperate) 39%, and "Dega" (temperate) 12%.The average annual rainfall is between 450-980 mm (CSA, 2005).

The total population is estimated at 4,334,996, consisting of 2,136,000 men and 2,198,996 women. 81.2% (3,519,000) live in the rural areas while the remaining 816,000 are urban dwellers with an estimated density of 86.56 people /Km2.

Description of the selected city

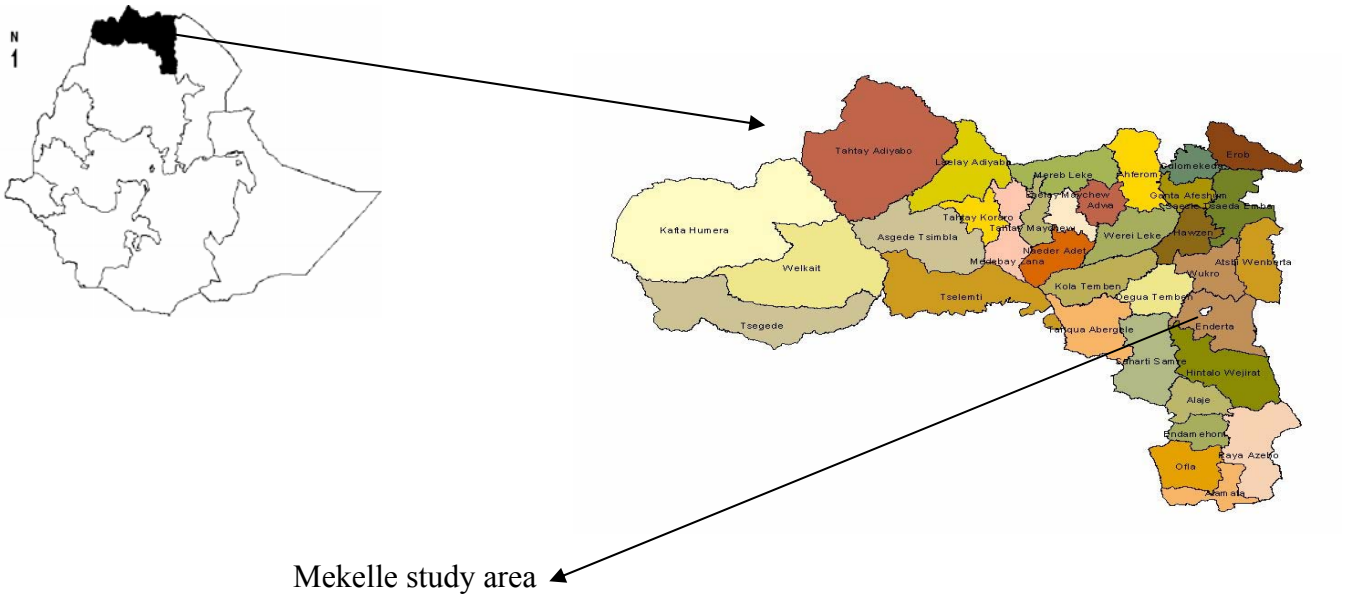
As part of the background of the study it could be necessary to indicate some aspects of the city profile of Mekelle. Mekelle is the capital and administrative center of the National Regional State of Tigray.

Mekelle is a special zone that comprises the city of Mekelle itself and including the town of Aynalem, with a total population size of 236,000,out of which about 90% of the total

population is believed to be orthodox Christians the remaining 10% being Muslims *(Mekelle City Development Plan and CSA,2007).*

According to the new administrative arrangement, the city is to be administrated by a mayor council system, in which municipal aspects are managed by a city manager. The total area of Mekelle city is 53 Km square (*Mekelle Strategic Plan 2005-2007*.)

Figure 3.1. Location Map of the Study Area



Source: Tigray BoFED, Information and Statistics Department (2007)

3.2 Sampling Procedure

A two stage stratified random sampling procedure is used to select the specific farm households (figure 2). Prior to sampling an initial complete listing (census) of all the dairy farms in the town is conducted. During the census, breed type (local and cross) and herd sizes were recorded for all households owning dairy farm.

In this study, the dairy farms were categorized into small, medium and large farm based on the herd size. The dairy farms categories and herd size of the farm in Mekelle and the surrounding peri-urban areas was adopted to categorize cross breed and local breed dairy farms in this study. Accordingly, farms owning 1-3, 4-10 and greater than 10 dairy cows were classified as small, medium and large farms, respectively. Thus, based on the breed type and number of dairy cows, the farms which owned local and cross breed cows in each of the farm size categories were identified. The result of this assessment indicated that there were only few large dairy farms of both local and cross breeds. Therefore, only small and medium size farms were considered for further data collection. Out of the farms that owned cross breed cows, 128 households categorized as small farm size group and the remaining 50 households categorized as medium size group. Regarding local cows owners, 128 households belong to small size group and the remaining 30 households belong to medium size group.

From the total of 336 dairy farms, 168 dairy farms (households) were considered for the study and this account for 50% of the total dairy farms in Mekelle. Out of this sample size, the number and the respective proportion of small and medium size farms included in the study were 98 and 70, respectively. The total number of medium sized farms owning local breed cows was 30; hence, all of the 30 medium size farms that owned local cows were included in the study. Out of 50 medium sizes cross breed dairy cows owners, 40 household were selected. Similarly from 98 small farms included in the study, 45 small sizes cross breed and 53 local breed cow owners were randomly selected. Dairy farm households were selected using a simple random method. Summery of the number of farms included under each of the four farm size categories are shown in Table 3.1.

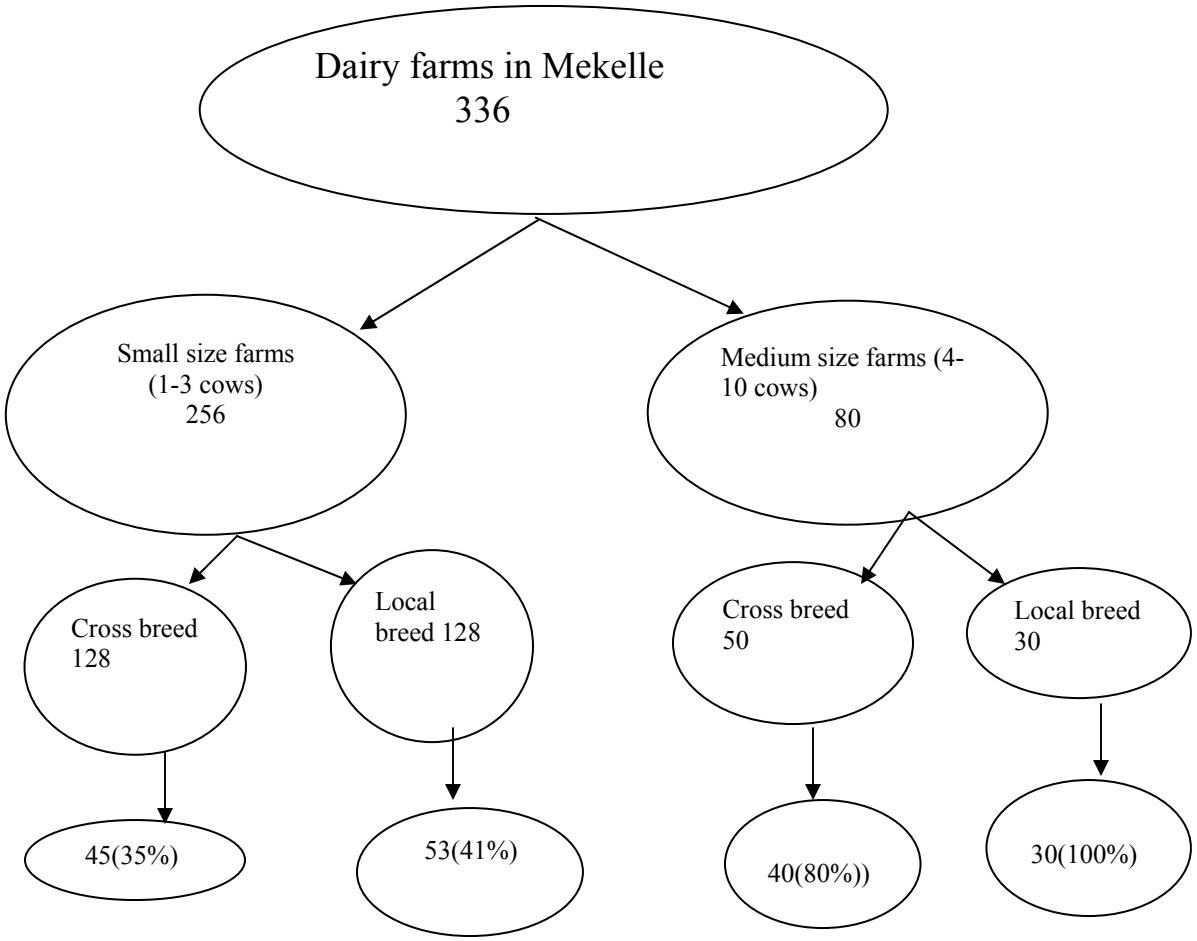


Exhibit 3.1. Showing the two stage stratified sampling employed to select sample farms

Table 3. 1. Sampled farms from each of the four categories

Categories	Cross breed cow Owners (No)	Local breed cow Owners (No)	Total (No)
Small size (1-3 cows)	45	53	98
Medium size (4-10 cows)	40	30	70
Total	85	83	168

No = Number

3.3. Data Collection

To study the production and marketing of dairy farming, one year cross-sectional data for the period from September 2009 to June 2010 were collected at the end of June. The primary data of each farm were collected using structured questionnaire. Trained enumerators administered the questionnaire.

The questionnaire is pre-tested and feedback is obtained from experts by distributing the draft questionnaire. The primary data collection mainly included the quantities and monetary value of the various inputs and outputs for one year. The data collected related to demographic characteristics of the household (household composition), herd structure of current stock (calves, bulls, heifers, cows etc), breed type, and current value of the animals, income sources (including sales of milk and milk products), types of feed, amount and sources of feed (purchased and/ or produced), price and amount of each input, milk and milk by-products produced and consumed, number of milking cows, age, stage of lactation etc., current liabilities, fixed assets: types and year of owned/ purchased and sources and amount of labor (family, hired labor, etc).

In addition, secondary data were collected from governmental and nongovernmental organizations, which are directly or indirectly involved in livestock development schemes, especially that of dairy. These include; Mekelle Zone Bureau of Agriculture and Natural Resources Development Office, Tigrai Region Bureau of Agriculture and Natural Resources Development Office, The Commercial Dairy Enterprises (Kalamino –TDA,

Agazi Dairy Farm, SOS Dairy Farm), The REST Office in Mekelle, The Mekelle Municipality. Besides, other related sources such as: books, archives, journals, project proposals, brochures, reports internets and other similar publications were exploited to the desired level.

The instruments of data collection include structural and semi-structural questionnaires, interviews, group discussions and personal observation. Simple analytical tools and statistical techniques like tables, percentages, graphs were used as per the need of the respective data analytical parts, to enrich the primary data.

3.4. Methods of Data Analysis

The primary and secondary data collected were summarized to describe households and farms characteristics. In addition, data on quantities of inputs, cost incurred in milk production and amount of milk produced and return obtained from milk and milk by- products are summarized to compute values of input parameters needed for production function model as well as cost-benefit and break-even analysis for the four categories of farms.

Household characteristics and farm data

The data on household characteristics and farms for medium and small size cross breed and local breed cows owning household collected were analyzed using descriptive statistic (average, percentage, cross-tabulation, etc.) and categories of farms were compared in terms of sex of household heads, education level of the household heads, family size, labor source, herd size, age and stage of lactation of cows, and milking days of cows.

Analysis of input data for production function, cost-benefit and break-even analysis

The resources (input) utilized for milk production of each household in terms of variable and fixed costs were calculated after identifying the inputs and amount consumed. The actual amount of inputs and their prices within the study period were collected through the interview.

The variable cost considered includes feed, labor, veterinary and insemination service, transportation, electricity, fuel, water, maintenance, tax and rent, stationary, interest on operating capital and miscellaneous costs. The estimated expenses on each of the inputs registered after deducting stocks and adding unpaid expenses. The fixed costs considered in the analysis include; depreciation of cowshed, bull and calves house as well as depreciation of the value of cows, depreciation of equipments and interest on fixed capital. Returns sources considered in the analysis include sale of whole milk, sale of cow dung, sale of cattle and appreciation of calves and heifers. The procedure used to estimate the cost of production and returns of the urban dairy farm in Mekelle town is described in Appendix 1

3.5. Production Function Analysis

The Cobb-Douglas production function model was fitted to data collected from sampled dairy farms. The model was fitted separately to data collected from the four categories of farms. The specific equation used was the following.

$$Y=b_0X_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}X_7^{b7}e^{u} \text{---------- (7)}$$

Were,

Y= Milk output/cow in Liters
X_1= Concentrate / cow/ in quintals
X_2 =Dry fodder/ cow/ in quintals
X_3= Green fodder / cow / in quintals
X4 = Labor / cow/ in person days
X5= Cost of miscellaneous / cow/ in Birr
X6= Stage of lactation / cow
e^{u}= error term

b_0 is the constant term (intercept) and b_1, b_2, b_3, b_4, b_5, b_6 are partial regression coefficients of Y with respect to X_1, X_2, X_3, X_4, X_5, X_6 variables, respectively. e^u is the random error term; assumed to follow Normal distribution with zero mean and constant variance. Zero order correlation was estimated to assess whether the multicollinearity exist between explanatory variables. Cobb-Douglas production function was estimated using ordinary least squares (OLS).

Cobb-Douglas production function is a power function; it was transformed into linear form by taking the logarithm of the Y and 'X' values. The resulting transformed form of the equation is used to estimate the parameters.

$$\mathbf{LogY = Log\ b_0 + b_1\ Log\ X_1 + b_2\ Log\ X_2 + b_3\ LogX_3\ \ b_4\ Log\ X_4 + b_5\ Log\ X_5 + b_6\ Log\ X_6 + LogE}$$

A multiple linear regression analysis was estimated and the independent variables considered were quantities of concentrate, dry fodder, green fodder in quintals, and labor in person days and miscellaneous expenses in Birr. In addition, stage of lactation of a cow was also included as independent variable. These variables are selected because they are used as inputs in the milk production process. Similar studies (Sharma et al, 2003, 2005) and Deepak et al., 2003 also used most of these variables to assess their influences on milk production.

Definition and measurements of variables

Milk output: The whole milk produced in the study year in terms of liters is considered as dependent variable. The produced milk sold and/or consumed in the home as well as feed for calves are recorded as a whole milk. In this study produced milk is evaluated as price of Birr 6/ liter.

Concentrate: Concentrate is one of the feed types used in most of the dairy farms in the study area. Concentrate feed is formulated mainly from bran mixed with bone meal and salt. In some farms bran is mixed with by- product of local drinks. The price of concentrate is determined based on the type of bran and mixed materials.

The price offered by farmers for a quintal of concentrate was fluctuating in the study period. For this study the purchasing price of concentrate was taken as Birr 178/ quintal (100kgs).

Dry fodder: Dry fodder can be in the form of hay, straw of barley, wheat and teff as well as maize stalk. Most farmers used a combination of the above fodder type purchased at harvest time and stored to be utilized in the forthcoming dry period. The price of dry fodder depends on the type of fodder and their availability. One fodder type can be a substitute for other. Farmers can use barely in place of maize stalk and wheat straw in place of barely straw or vise versa. Therefore, the price for a quintal (100kgs) of dry fodder is estimated at Birr 30 average for each fodder type in the study area was used.

Green fodder: Includes wet grasses and leaves of maize. The supply was mainly at rainy time in case of grass and at early (succulent) stage of maize plant. Green fodder used by most of those dairy farms located at the boundary of the near by rural farmers. The price offered by the dairy farmers depends on the amount, type and the distance to the suppliers. For this study the purchased price was taken Birr 25 for a quintal (100kgs).

Labor: Family and hired labors are sources of labor input in the study area. The family labor used was evaluated on the bases of man days conversion, which is eight working hours considered as one man day. For hired labor the actual payment was taken as cost for labor input by converting to equivalent man days. The wage rate is estimated at Birr 5/ person days.

Miscellaneous cost: This cost is part of operating expenses incurred to purchase miscellaneous inputs other than those inputs indicated above but used for milk production in the study area. Since the expenses are part of capital, the opportunity cost for one Birr additional cost on these inputs taken as one Birr plus the interest charge at prevailing 4% interest rate, which comes to be Birr 1.04.

Stage of lactation: The potential of cows in milk production could be directly related with the age and stage of lactation. Cows at early and late stage of lactation produce relatively lower yield than those cows at an intermediate lactation stage. Stage of

lactation of a cow is directly related to age, there is a considerable variation in the persistency of milk production following peak production in early lactation (Compbell et al, 2006).

3.5.1 Marginal value of product

Estimates of marginal productivity of factors of production are derived at the mean of each factor (input) and output used. Thus marginal value of productivity of each factor is computed as derivative of output i.e. income from milk with respect to input at its mean level computed using the respective b_i of the Cobb Douglas production function, others things held constant. The MVPs in monetary term of input is computed for those inputs statistically significant in the estimated production functions.

$$MVP_{xi} = b_i \frac{\overline{Y}}{\overline{X_i}} \quad \text{..... (8)}$$

Where;

b_i =Elasticity coefficient of i^{th} input in production function

$\overline{X_i}$ =Geometric mean of i^{th} input

$\overline{Y}$ = Estimated levels of return from milk when all inputs are at geometric mean level

Production is said to be efficiently organized under perfectly competitive condition in the output and input markets when the marginal products were equal to their respective factor costs. And $\overline{Y}$ will be computed when all inputs were fixed at their sample mean and, multiplied this quantity with b_i the coefficient of X_i and divided by $\overline{X_i}$ obtained the MVP of X_i when input was at the mean level.

3.5.2. Return to scale

One of the most important measures in the study of production and resource use is the concept of elasticity. The elasticity of production indicates the change in output relative to the change in input. Partial regression coefficients of the production function equation were considered as elasticity coefficients of the

independent variables and indicate the contribution of those inputs in the value of milk and milk products. Thus, partial regression coefficients measure the individual contribution of the respective inputs. These b_i values were then summed up to measure the aggregated percentage share of the independent variables of milk production for the four categories of farms. The sum of elasticity coefficients measure the percentage changes in dependent variable for a percent change in the independent variable. The sum of elasticity equals to one, less than one and greater than one which indicats constant, decreasing and increasing return to scale change in the independent variable, respectively.

3.6. Farm Efficiency and Profitability Analysis

In this study, cost-benefit ratio and break-even analysis are used to measure the efficiency of categories of farms studied. This is used to assess the efficiency and profitability differences among the four categories of dairy farms.

3.6.1. Cost-benefit

Cost-benefit ratios are computed for the four categories of farms studied. To this effect, the annual total production cost and gross return values are estimated for categories of the farms. The following formula is employed.

$$\text{Cost} - \text{Benefit Ratio} = \frac{\text{Gross return}}{\text{Total production cost}} \quad \text{---------- (9)}$$

The total production cost of a farm includes variable cost and fixed cost. Gross return is computed by subtracting production cost from total return. The profitability of the four categories of farms is compared based on the cost-benefit ratios

3.6.2. Break-even output

In this study break-even output is computed based on total fixed cost per animal and the differences between price and variable cost per liter of milk. The following formula is employed.

$$\text{Break – even output} = \frac{\text{Total fixed cost per animal}}{\text{Price per liter – Variable cost per liter}} \quad \text{----------(10)}$$

Break-even output is the output level at which farms need to produce to cover their fixed cost incurred in the production. The estimation of break-even output consider the average fixed cost and milk produced per cow, variable cost and selling price of a liter of milk. The variable cost per liter is obtained from average variable cost divided by average milk yield of a cow. For the analysis the average market price of six Birr / liter over the study period is considered. The percentage share of break-even output form the actual milk produced is derived from the break-even output divided by the actual average milk production to assess the efficiency and profitability of farms and to make comparison among the four categories of farms studied.

CHAPTER IV

RESULTS AND DISCUSSION

INTRODUCTION

Dairy production is one of the main elements of urban agriculture that is undertaking by both intensive (modern) farmers and smallholders. This is getting an increasing ground. With the ever growing human population and the emerging change in pattern of life with urbanization there is in proportionate production of milk or supply of milk

The process of milk production however is not an easy task. It involves financial, labor, material and similar other factor inputs. Dairying, by its nature, is also a peculiar activity that could not be managed/covered by the regular working hours, rather it needs longer hours.

Hence, in this study different parameters and data types are taken into account for better assessment. These are, general background of the producers, milk production and some aspects of marketing, feed and feeding, and breed types of animals. Dairy farms and environmental impacts, and similar other problems and prospects of dairy farming are treated in the process of situational analysis of dairy production in Mekelle.

For the purpose of data collection tools like questionnaire, interview and discussions are employed from each respective group. 168 households are selected from a total of 336 dairy farms by randomization technique. Data are collected, summarized and expressed using percentages, frequencies, table and graphs.

The secondary data reveals that the total livestock population of Mekelle town is 117,142 of which cattle account for 41,379, sheep and goat constitute 11,203, pack animals composed of 5,250 and poultry 59,310.

The annual total milk production of the city in 2009/10 is 2,209,720. The contribution of the estimated annual milk yield of the crossbreed is 2,091,133 (Tigray Bureau of Agriculture and Natural Resources)

4.1. Description of Dairy production, Farm, household characteristics and challenge to Dairy farms

4.1.1. Characteristics of dairy production systems in Mekelle

In general there are two major milk production systems in Mekelle namely

A. Modern /intensive dairy farms

B. Smallholders dairy farms

4.1.2. Modern /intensive dairy farms-in brief

Under this category the existing three modern dairy farms in Mekelle namely: ***Kalamino, Agazi*** and SOS dairy farms are available**.** They have modern management systems and supply better quality milk and milk products. These farms in establishments have their own respective motives besides their common practical supply of fresh milk to the market.

Kelamino dairy farm is located in the southern part of Mekelle and was established in 1989 E.C by Tigray Development Association (TDA) as part of its development schemes for its objective of producing and supplying fresh milk to the people of Mekelle. According to the information from the farm manager of Kelamino dairy farm more of the market outlet are government and non government employed clients mainly on contract or monthly payment basis, the remaining, in fact is sold on daily basis, which accounts insignificant in amount. The farm has organized six strategic selling centers for its fresh milk market outlet namely: TDA (01) , Kebele 03, Kebele 05, ,Kebele 17, Kebele 18, ***Adishumdhun*** and at the farm gate for the workers in the organization.

Agazi dairy farm, which is situated in the northern part of the city, was organized in rehabilitating members of the TPLF war veterans in 1987 E.C, considering Mekelle as its target market.

However, **SOS** dairy farm was established in 1971 E.C intended to supply with dairy products to the children of Mekelle SOS Children's Village, since it is a welfare organization. The total milk production for each dairy farm is given in Table 4.1

Table 4.1. Milk production of the modern dairy farms, 2010

Name of the farm	№ of lactating cows	Total milk production/ day	Average milk /cow
Kalamino	72	600 liters(54.5%)	8.33 liters
Agazi	44	400 liters(36.4%)	9.10 liters
SOS	10	100 liter(9.1%)	10 liters
Total	126	1100 liters	8.7

Source: Respective (Kalamino, Agazi and SOS) working documents of the farms, 2009/10

As can be observed from the Table 4.1 the total daily production of milk is high in **kelamino farm** and the lowest being in **SOS** farm that corresponds to the existing proportional number of lactating cows in each respective farm. Thus, **kelamino** covers 54.5% of the total daily production. However, the average milk production per cow is high in SOS dairy farm, which is 10 liters. The reason could be due to the small size of the milk cows (10) in number that increases efficiency in management and there by productivity. The total daily production by the three intensive farms is 1100 liters

4.1.3. The Smallholders Dairy Farms

These are the second category of the dairy farms in Mekelle that is under taking at household level. This dairy production system is not a uniform pattern. Rather one could observe different features with in the smallholders. These are:

i / Small holders who purely produce and supply fresh milk to the Market.

ii/ Small holders who produce milk but supply their products to retail shops

(cafeteria)

iii/ Mixed small holders mainly located in the peripheral areas of the city , cereal production is their main occupation but they also raise animals for draught and produce milk to sell in the market. They are sometimes referred to as “subsistence-farmers”.

4.1.4. Farm and household characteristics

From the total farms surveyed (168), 75% are male-headed household while 25% are female-headed household. Out of the total 85 cross breed farm owners, 62 are

male and the remaining 23 are female and Out of the total 83 local breed farm owners, 64 are male and the remaining 19 are female (Table 4.2). In general, female- headed household farms owned cross breed and local breed farms were few as compared to farms owned by male-headed household.

The maximum family size of cross breed farm owners is 9 persons while it is 12 persons for local breed farm owners. The over all average family size of medium and small size cross breed farm owners is 7.35 and 7.24 persons, respectively. Family size for medium and small size group of local breed cows owning farms were 8.33 and 6.85 persons, respectively (Table 4.2).

Table 4.2. Households and family members (%)

Description	Categories of farms					
	Cross breed farms			Local breed farms		
	Medium N=40	Small N=45	Overall N=85	Medium N=30	Small N=53	Overall N=83
	%	%	%	%	%	%
Household Head						
Male	75	71	73	90	70	77
Female	25	29	27	10	30	23
Family member						
Male	45	55	47.7	41	59	54
Female	49	51	52.3	40	60	46
Total	47	53	100	41	59	100
Average family size	7.4	7.2	8.5	8.3	6.8	7.4

Source: Survey, 2010

Note: N= Sample size

Education level of the sample house holds

The survey result revealed that among cross breed farm owners, 11% are illiterates 6% can read and write, 60% have attended grade 1 to 12, 16% have diploma and 7% attended first degree and post graduate studies. Among local breed farm owners, 23% are illiterates, 13% can read and write, 57% completed grade 1 to 12 and 7% are Diploma holders.

The shares of illiterate, read and write and 1- 6^{th} grade are larger in local breed farm owners than cross breed farm owners. Where as, the share of diploma

holders are larger in cross breed farm owners (16%) than local breed farm owners (8%) (Table 4.3).

Table 4.3. Educational level of the household heads of the dairy farms (%)

Education level	Cross breed farms			Local breed farms		
	Medium (N=40)	Small (N=45)	Overall (N=85)	Medium (N=30)	Small (N=53)	Overall (N=83)
	%	%	%	%	%	%
Illiterate	2.5	18	11	27	20.8	23
Read & write	7.5	4	6	20	9.4	13
1-6th grade	25	29	27	30	30.2	30
7-12th grade	32.5	23	33	20	30.2	27
Diploma	17.5	33	16	3	9.4	7
Degree	10	16	5	-	-	-
Post- graduate	5	0	2	-	-	-
Total	100	100	100	100	100	100

Source: Survey, 2010
N=Sample size

4.2. Inputs Utilization in selected Dairy Farms

In this study, home produced and / or purchased inputs were identified and data on the amount utilized in the farm were collected. The survey result revealed that, the majority (52%) of cross breed cow owners used concentrate (bran and oilcake), as well as rouphage (hay and green fodder). Where as, with the exception of few households, which used bran, the majority (60%) of local breed farms used mainly green fodder. It is also observed that cross breed farm owners spent (10%) of their income for electricity, water, medicine and veterinary service. Some households incurred transportation expenses for disposing cow dung.

Labor source and utilization in the dairy farms

Labor is among the major inputs in dairy farming in the studied area. All labor hours utilized in dairy farming are converted into man days. Both hired and family labors were used in the study area in dairy farming activities. Majority of cross breed dairy farms owners (73%) used hired labors. Both small and medium size cross breed farms use 335 man days in a year. On average 8 man days per farm is used in both cross breed farms. Hence, it is accepted that Dairy farming provides employment opportunity in Mekelle. The majority of local breed farm owners' households (77%) used family labors. On average194 person days per year is used in a year in Mekelle town (Table 4.4).

Table 4.4. Average family size and labor used in man days per year

	Farm type and size			
	Cross breed		Local breed	
Farm size categories	Family size (persons)	Man days	Family size (Persons)	Man days
Small size	7.24	224	6.85	146.8
Medium size	7.35	445.8	8.33	278.6
Overall	8.47	335	7.39	194.4

Source: Survey, 2010

Utilization of family and hired labor in different activities of dairy farming is also assessed. In case of local breed farms, milking, feeding and cleaning activities are done by family labor as reported by 99% of the sampled households. On the other hand, managing the farm, guarding, purchasing and selling activities were performed by family labor as reported by 74%, 12%, 27% and 16% of the sampled households. Family labor was utilized for most of the activities by small size than medium size cross breed farms. Similarly for local breed farm owners, the share of family labor was higher for small farm size than medium size farms categories (Table4.5).

Table 4.5. Family and hired labor utilization (%)

Activities and labor types	Cross breed farms			Local breed farms		
	Medium (N=40)	Small (N=45)	Overall (N=85)	Medium (N=30)	Small (N=53)	Overall (N=83)
	%	%	%	%	%	%
Milking						
Family	52.5	82	68	96	100	99
Hired	47.5	16	31	3	0	1
Feeding						
Family	32.5	80	58	96	100	99
Hired	67.5	20	42	3	0	1
Cleaning						
Family	35	82	60	97	100	99
Hired	65	18	40	3	0	1
Managing the farm						
Family	55	64	60	50	87	74
Hired	22.5	4	13	3	0	1
Both	22.5					
Guarding						
Family	2.5	4	4	40	30	12
Hired	35	7	20	10	13	12
Both	62.5					
Purchasing						
Family	40	36	38	17	32	27
Hired	2.5	4	4	0	0	0
Both	57.5					
Selling						
Family	48	40	44	3	23	16
Hired	20	9	14	0	0	0
Both	32					

Source: Survey, 2010

N= Sample size

With regard to division of labor among female and male in case of cross breed farms, milking, managing the farms and selling of milk and milk by-products were performed by females while, feeding, cleaning, guarding and purchasing of inputs were done by male (Table 4.6). All activities, except guarding were performed by females in the case of local breed farms. For both cross and local breed farms of small size categories, most activities were carried-out by females. In the case of medium size cross breed farms most activities were mainly performed by males while, milking was done equally by males and females. On local breed medium size farms, female performed milking and males performed cleaning and

feeding, guarding, purchasing, and selling. Management of the whole farm activities was performed by both male and female. There fore male and female have almost equal contribution in Dairying activities (Table 4.6).

Table 4.6. Dairying activities done by male, female or both

Activities and sex	Cross breed farms			Local breed farms		
	Medium (N=40)	Small (N=45)	Overall (N=85)	Medium (N=30)	Small (N=53)	Overall (N=83)
	%	%	%	%	%	%
Milking						
Both	5	7	6	3	0	1
Male	47.5	31	39	13	6	9
Female	47.5	62	55	83	94	90
Feeding						
Both	0	13	7	10	17	14
Male	80	31	54	47	6	21
Female	20	56	39	43	77	65
Cleaning						
Both	75	11	6	0	13	8
Male	25	33	53	23	4	11
Female	17.5	56	41	77	83	81
Managing the farm						
Both	22.5	18	18	23	36	31
Male	45	20	21	13	6	8
Female	2.5	31	38	17	45	35
Guarding						
Both	16	0	1	3	2	2
Male	0	5	21	47	34	39
Female	5	2	1	0	5	5
Purchasing						
Both	5	7	6	3	11	8
Male	27.5	18	22	3	11	8
Female	10	16	13	13	4	7
Selling						
Both	5	7	6	0	6	4
Male	30	18	24	3	0	1
Female	32.5	24	28	0	15	10

Source: Survey, 2010
N= Sample size

4.3. Description of the Studied Dairy Farms

Age and stage of lactation of milking cows

The study result revealed that the average age of the surveyed cows was 7.2 years for local breed and 6.05 years for cross breed farms. The overall average age of cross breed cow 6.05 years is less than local breed cow farms 7.2 years. Thus, cross breed cows were younger and relatively started producing milk at earlier age than local breed cows.

The stage of lactation means the number of calving time by a cow. The over all stage of lactation (the number of calving time by a cow) for local breed farms was 3.2 and that of cross breed farms was 3.1. The medium size cross breed farm group resembled higher lactation stage 3.2 than medium size local breed owner group (2.97). Small size local breed owners group had cows at higher stage of lactation 3.3 than small size cross breed farms owners group (Table 4.7).

Table 4. 7. Age and stage of lactation of dairy cows at Mekelle

Descriptions	Cross breed farm group			Local breed farm group		
	Medium N=40	Small N=45	Over all N=85	Medium N=30	Small N=53	Over all N=83
Total cows (No)	178	76	254	126	67	193
Max. age of cow (year)	10	11	-	12.75	13	
Min. age of cow (year)	2.2	3	-	4.5	3	
Average age of cow (year)	5.9	6.2	6.05	7.2	7.1	7.2
Max Stage of lactation	5.4	9.3	-	4.75	8	
Min. stage of lactation	1.5	1	-	1.5	1	
Stage of lactation (No)	3.2	3	3.1	2.97	3.3	3.2

Source: Survey,2010
N=Sample size
Max.= Maximum
Min= Minimum

Milking days of cows

The survey result showed that the overall average milking days in the study period of local breed cow owner farms is 227 days while it is 237 days for cross breed cow owner farms/cow/year. The average milking days of a cow in medium and small size cross breed farms groups are 288 and 256 days, respectively. A cow on the average had 199 and 243 milking days in medium and small size local breed farms. The milking days of a cow for medium size cross breed cows owner farms (288) were larger than a cow in medium size local breed farms (199). And, a cow in small size cross breed had more milking days (256) than a cow in small size local breed farms (243). In general, cross breed cow had larger milking days than local breed cows (Table 4.8). Small size farm owner household reported that, they milked a cow with out stopping even at the period when a cow is pregnant. However, medium size farm owners were reported that they do not milk a cow especially at last months of pregnancy.

Table 4.8. Lactation period of a cow for local and cross breed cows owning farms

Descriptions	Cross breed farms			Local breed farms		
	Medium (N=40)	Small (N=45)	Overall (N=85)	Medium (N=30)	Small (N=53)	Overall (N=83)
Total cows (No)	178	76	254	126	67	193
Max. milking days/cow (No)	306	333	333	285	250	285
Min milking days/cow (No)	171	145	145	128	185	128
Average milking days/cow (No)	288	256	237	199	243	227

Source: Survey, 2010

N=Sample size

Milk production of the dairy farms

The survey results revealed that on the average a cross breed cows owning farm produced 6850 liters per farm per year while milk production was 1306 liters per farm per year for local breed cows owning farms. The overall average milk production for cross breed cows owning farms is 2292 liters per cow per year and that of local breed cow farm is 573 liters per cow per year.

The average milk production of a cow is 2162 and 2598 liters per year for medium and small size cross breed farms, respectively and that of local breed cow is 533 and 647 liter per cow per year for medium and small local breed farms, respectively (Table 4.9).

Table 4.9. Annual milk production of dairy farms at Mekelle town

Description	Cross breed farms			Local breed farms		
	Medium (N=40)	Small (N=45)	Overall (N=85)	Medium (N=30)	Small (N=53)	Overall (N=83)
Total cows (No)	178	76	254	126	67	193
Cow/farm (No)	4.45	1.69	2.99	4.2	1.26	2.32
Total milk (liter)	384785	197430	582215	65038	43334	108372
Milk/ farm (liter)	9620	4387	6849.5	2168	818	1306
Milk /cow (liter)	2162	2598	2292	533	647	573

Source: Survey, 2010
N= Sample size

Occupation of the respondents

Table 4.10. Types of major occupation of the respondents

Occupation	Number of respondents	%
Civil servant	38	23
Private job	84	50
Unemployed	46	27
Total	168	100%

Source: Survey, 2010

As the survey indicates most dairy farmers do not take dairying as a sole career except 27% of the respondents. However, 50%of them have supplemented their life earning by other private activities and 23 % are civil servants. Therefore, dairy farming is not taken as an exclusive means of earning income by at least 73% of the total respondents.

Motives for investing in dairy farming

The table (4.11) indicates that 50% of the households have been motivated for the main reason that they would enjoy better life. The remaining 18% of the households (part timers) and 15% (those who considered dairy as supplementary job) have been involved in this activity to get additional income.

Table 4.11. Motives for investing in dairy farming

Motive	Number of respondents	%
Part time job	30	18
As supplementary job	26	15
profitability	84	50
Others	28	17
Total	168	100

Source: Survey, 2010

Source of feed

Most of the dairy farms are not using grazing system. The table 4.12, therefore, confirmed that 90% of the households purchase and feed their cattle. 5% of the dairy farms use their own grass lands to feed their cattle and others (5%) purchase animal feed and use their own grass land.

Table4.12. Source of feed

S/N	Item	Alternatives	Number of respondents	%
	Feed sources	purchased Own grassland Combination	152 8 8	90 5 5
Total			168	100

Source: Survey, 2010

Water

As indicated in the Table 4.13, mostly the water source for the animals is tap water. That is 77% of the households depend on tap water. When there is scarcity of tap water, *Water well* and *River/*stream *is some times* used. Watering frequency is 1 or 2 times per day as informants explained.

Table 4.13. Drinking water source for the animals

S/N		Sources of water	Number of respondents	%
		Tap water Water well River/stream	130 20 18	77 12 11
Total			168	100

Source: Survey, 2010

Feed price

About 90% of the households depend on zero grazing and thus purchased feed, including that of ***atella***. 80% of the respondents have reacted that the price of animal feed is too expensive. Of course, price varies with the changes in seasons, especially that of hay and crop residues.

Variability of feed price in the year is a serious problem. 100% of the respondents have exclusively agreed that the price of animal feed shows continuous change all the year round in an increasing rate. There is particularly a dramatic increase in between the months of August and September. There is almost a 100% increment particularly in between May and August.

Besides, as informants explained that, most smallholders do not have access to the factory price. Rather, they mainly are forced themselves to buy from the retailers at higher price. This obviously negatively affects the profitability of milk in the market. According to the Mekelle Zone Agriculture and Natural Resource Bureau, the cost of 1 tone of rafage is 500 birr.

Table 4.14. Perception of respondents towards feed price in the market.

S/N	Item	Alternatives	Number of respondents	%
	Price of animal feed in the market	Expensive Medium Cheap	135 33 -	80 20 -
Total			168	100

Source: Survey 2010

Marketing

It is pointed out that market oriented milk production was started in **Mekelle** around 30 years before. One of the most critical issues of the milk producers is whether market is available. More than 80% of the suppliers agreed that they get market to their products at the minimum price of Birr 6/liter.

However, there is no smooth process of selling their milk products all year round. Rather about 83% of them are suffering the absence of market during the Christian fasting that recurs at different intervals of the year, particularly, the longer fasting period before Easter and the 15 days in August. Almost all the suppliers fail to get market. The problem is that the shelf life of milk is short (Survey, 2010).

Prospects of unsold milk

Though the unsold milk is consumed in different forms (self consumption, distributing to neighbors and relatives), they realized this milk as wastage. Some of them in fact try solving the problem by converting into butter. 10 liters of milk almost produces 1 kg butter that could get a selling price of birr 60. This is really applied by most of them as a remedy.

Because the market price of 10 liters is almost equivalent to 1 kg butter. Since the shelf life of butter is long the producers could accumulate and sell it during the non-fasting period. But the problem is that all of the producers never use modern machine (chroner) to separate butter from milk. They rather use the cultural method of separation (Primary data, 2010).

Major consumers of milk in the market.

On the demand side the consumers of milk are different natures among which 60% are households' consumers and the remaining 40% are institutions like colleges and hospitals.

Table 4.15. Major consumers of milk in the market

Alternatives	Number of respondents	%
-Household consumers -Business center	100 68	60 40
Total	168	100

Source: Survey, 2010

The result in Table 4.16, indicates that the market outlets could either be on retail basis or whole sale basis or both on retail and whole sale basis that is 50%, 25% and 25% respectively.

Table 4.16. Market outlets for milk

Alternatives	Number of respondents	%
On retail basis On whole sale basis Both on retail and whole sale basis	84 42 42	50 25 25
Total	168	100

Source: Survey, 2010

With regard to distribution 53 percent of the producers sell their milk at home while 29 percent of them are itinerants (home to home selling).

Table4.17. Selling place of milk

Alternatives	Number of respondents	%
At home	89	53
Distribution centers	30	18
home to home selling	49	29
Total	168	100

Source: Survey, 2010

Milk price

The current prevailing milk price is not observed to be uniform. The price ranges from birr 6-7. Accordingly the selling price of milk (market price) was Birr 6 before some months. Currently it is Birr 7 in most of the dairy farms (Primary data, 2010).

It is pointed out that, 95% of them have strongly responded that the prevailing milk price shall not under mined. If it is under mined, compensated the high costs of production mainly that of feed of animals is very difficult. As it is already sated in the discussion part of feed and feeding, the cost is high since the region is draught prone and the scarcity of factories that provide their by products as feed.

Therefore 65.52% of the producers have proposed that the selling price of milk to be birr 7.50 and 20.69% of them to be birr 8.00, while the reaming are abstainers in this regard (Primary data, 2010).

Animal disease and their prevention

The points given in table 4.18 are the common diseases of animals in Mekelle.

Table 4.18. Farm house holds affected by animal disease

Animal disease	Number of respondents	%
Blackleg	45	9
Bovine pasterelloosis	111	22
Lumphy skin disease	30	6
Actinomycocis	99	20
Mastitis	114	23
Dystocia	105	21
Total	504	100

Source: Survey, 2010

As indicated in Table 4.18, most of the animals are affected by Mastitis (23%), Bovine pasterelloosis (22%), Dystocia (21%) and Actinomycocis (20%). Blackleg and Lumphy skin are less severs disease in the study area.

According to the Mekelle Zone Agriculture and Natural Resource Bureau, the major types of animal diseases are Mastitis, Blackleg, Bovine pasterelloosis, Lumphy skin disease, Actinomycocis and external parasite. Their control mechanism is most of the time Vaccination, Sanitation (Treatment) and good Management.

Table 4.19. Animal disease and their prevention

S/No	**Items**	**Animal disease and control mechanism as by the respondent**
1	The major types of animal disease	- Blackleg, Bovine pasterelloosis, Mastitis, Actinomycocis and Dystocia
2	Possible ways to control transmission	-Seasonal vaccination Hygenical status
3	Possible control method of animal disease	-Seasonal vaccination Hygenical status, Immunizaton, Injected antibiotics, seasonal dosing of Antihelmentics and Acaricides, Isolate the sick animal, proper treatment for the sick animal.

Source: Survey, 2010

4.4. Production Function Analysis

The regression analysis was carried out on the log value of dependent variables (milk output in liters) and independent variables of concentrate, dry fodder, and green fodder in quintals, labor in man days, miscellaneous cost (Birr) and stage of lactation. Before fitting the data to the regression analysis, a multicollinearity test of the dependent and independent variables was carried out. The analysis of the production function and the out put on regression estimates and associated parameters, return to scale, the marginal value products (MVPs) and the optimum level of inputs were computed for the four farm categories.

4.4.1. Correlation of variables

The partial correlation between dependent and independent variables and multicollinearity test were carried out. The correlation matrix of multicollinearity result presented in Appendix 11,12,13,14. The result showed that there is no severe correlation between independent variables. Thus all the independent variables were considered in the regression analysis.

4.4.2. Production function estimates

The estimates of the production function analysis and associated parameters, standard error, t-test value of the estimates as well as the adjusted R^2 the coefficients of determination, the sum of regression coefficients, the F-test values are presented in Table 4.20.

The coefficients of determination, the adjusted R^2 values for medium and small size cross breed farms are 0.49 and 0.52, respectively. The values for medium and small size local breed farms are 0.57 and 0.47, respectively. The value of adjusted R^2 shows that 49% and 52% of the variation in milk production for medium and small size cross breed farms as well as 57% and 47% of the variation in milk output for medium and small size local breed farms of the study area would be explained by the explanatory variables in the production function. Hence, inputs are critically limiting the production of local and cross breed farms. Therefore this is accepted as it is already indicated in the hypothesis. The F-values of the regression analysis are also significant at 10% level for all farm size categories.

The regression coefficients (b_i) estimated in the production function, the values of concentrate are positive and significant at 10% level for medium and small size cross breed farms, respectively. While positive and not significant for medium and small size local breed farms, respectively. This means the analyst is 90% confident that this input contributes in medium and small size crossbreed farms for output but has small difference whether this input is used or not in the case of medium and small size local breeds farms. Therefore this input accounted for a significant impact in cross breed owning farms than local breed owning farms from the

production cost (Table 4.25). The over all annual production cost for cross breed and local breed are 39% and 26%, respectively. This indicates the higher the annual production cost, the more contribution it has.

The coefficients for dry fodder are positive for all farm size categories, but significant at 10% level for medium size cross and local breed farms and significant at 5% level for small size local breed farms. Where as dry fodder is insignificant for small size cross breed farms. This input accounted for a significant impact in local breed owning farms than cross breed owning farms from the production cost (Table 4.25).

The coefficients for green fodder are positive but insignificant for medium and small size cross breed and positive and significant at 5% level for medium size local breed farms while, negative and insignificant for small size local breed farms. The test result indicated there is no more difference to use this input fore medium and small cross breed but significant at 5% incase of medium size local breed. Green fodder accounted for a significant impact from the total production cost of local breed owning farms than cross breed owning farms. Green fodder accounted greater production cost in local breed owning farm than the costs of cross breed owning farms but the negative and insignificant coefficient indicates the absence of green fodder to milk out put (Table 4.25).

Regarding the coefficients for labor, they are negative and insignificant for medium size, positive and significant at 5% level for small size cross breed farms and positive and insignificant for medium and small size local breed farms. As it is estimated, the analyst has 95% confident that labor contributes highly for small size cross breed farms and has less contribution both for medium and small size local breed but this input indicated the absence of its contribution to milk output incase of medium size cross breed farms. This input accounted for a significant share in small size cross breed owning farms from the production cost (Table 4.25).

The coefficients for miscellaneous cost are negative and positive insignificant for medium and small size cross breed farms, respectively, while positive and significant at 10% level for medium and small size local breed farms. As it is estimated, the analyst has 90% confident that miscellaneous cost has highly needed for medium and small size local breed but it indicated the absence of its contribution to milk output for medium size cross breed. Therefore this input accounted for a significant share in local breed owning farms than cross breed owning farms interims of cost benefit. Because the over all annual production cost of local breed 7% is less than 10% in the case of cross breed owning farms (Table 4.25).

In respect to the coefficients for stage of lactation, they are positive and insignificant for medium and small size cross breed and medium size local breed farms. It is negative and insignificant for small size local breed farms. As it is estimated, the share of stage of lactation has small difference for medium and small size cross breed and medium size local breed farms. These negative and insignificant coefficients of the respective independent variables indicate the absence of their contribution to milk output in the study area.

In general the regression coefficients of the production function indicates, cross breed farms are more beneficiary from the inputs concentrate and labor than the other inputs. These farms need more cost for these inputs so as to get more return. On the other hand using more dry fodder, Green fodder and less miscellaneous cost is more important for local breed farms because of the cost benefit analysis. These farms need high cost for green and dry fodder but need less miscellaneous cost to get more return. So local breed owning farms prefer to use these inputs.

Table 4.20. Estimated production function coefficients

Inputs	Farm size categories			
	Cross breed		Local breed	
	Medium N=40	Small N=45	Medium N=30	Small N=53
Constant term	5.78	5.15	4.19	4.99
Concentrate (qt)				
b_i	0.36*	0.26*	0.015	0.12
SE	0.19	0.12	0.059	0.08
t	1.88	2.20	0.261	1.45
Dry fodder (qt)				
bi	0.15*	0.097	0.26*	0.136**
SE	0.08	0.069	0.142	0.065
t	1.86	1.42	1.83	2.08
Green fodder (qt)				
b_i	0.017	0.06	0.184**	-0.012
SE	0.082	0.06	0.076	0.036
t	0.21	0.99	2.41	0.341
Labor (man day)				
b_i	-0.029	0.27**	0.063	0.036
SE	0.23	0.14	0.219	0.156
t	0.13	1.87	0.288	0.23
Miscellaneous cost (Birr)				
b_i	-0.04	0.145	0.157*	0.179*
SE	0.15	0.098	0.088	0.104
t	0.28	1.48	1.782	1.85
Stage of lactation				
bi	0.16	0.022	0.09	-0.103
SE	0.21	0.142	0.22	0.125
t	0.76	0.142	0.22	0.83
R^2	0.49	0.52	0.57	0.47
F-test	7.68	9.75	7.95	9.40
Sumofb_i	0.62	0.85	0.77	0.36

N= Sample size

b_i = Elasticity coefficient

SE= Standard error

t ='t'- value

** = Significant at 5% level

* = Significant at 10% level

qt= quintal (100kgs)

4.4.3. Return to scale

The return to scale relationship between inputs and output could be seen from the sum of the regression coefficients (elasticities). It is assumed that the sum of elasticieties of one, the return to scale is constant, if the sum is less than one, the return to scale is decreasing, and the sum of elasticieties greater than one indicates increasing return to scale. That means for equal proportion increase in inputs, the response of milk output is at equal proportion the scale is constant, the response is less than proportional, the scale is decreasing, and the response is greater than proportional, the scale is increasing.

The sum of regression coefficients (elasticities) for medium and small size cross breed farms is 0.62 and 0.85, respectively. For medium and small size local breed, the sum of the regression coefficients is 0.77 and 0.36, respectively (Table 4.20). The scale relationship between input and output (return to scale) are in the range of decreasing return to scale for all farm size categories. These results indicates that, for equal 100% in increase of the inputs in the production, the milk output would increase by 62% and 85% for cross breed and 77% and 36% for local breed medium and small size farms, respectively. The decreasing return to scale might be the results of diseconomies of scale because of some indivisible factors of production may be come inefficient and less productive. And, the coefficients of input in the production function are negative. Therefore from this what the analyst can conclude is that for 100% in increase of the inputs in the production, the milk output would not necessary increase by equal amount of proportion. This is because of diseconomies of scale that some factors of production may be inefficient and less productive.

4.4.4. Marginal value products (MVPs) of inputs

The efficiency of resources used for milk production was assessed for the four farm size categories. The efficiency of resources (inputs) was examined through marginal value products. The estimates of the MVPs worked out for those inputs found significant in the production function and they are given in value terms. Each value of the marginal product indicates that the expected increase in milk output

(income) generated from the use of an additional unit of input factor, the value of other inputs remaining unchanged. The MVPs of any resource depends on the quantity of it already being used and on the level of the other resources with which it is combined in the production process (Heady and Dillon, 2003). There fore, the value of marginal productivity of input factors are derived at the mean of each input factor level and output (milk). The marginal value productivity is computed as derivative of output (milk) with respect to mean level of inputs which found to be significant in the production function. The MVPs derived are given in table 4.21.

Table 4.21. Marginal value product derived for significant coefficients by farm size categories

Inputs	Size categories			
	Cross breed		Local breed	
	Medium N=40	Small N=45	Medium N=30	Small N=53
Production elasticities (b_i)				
Concentrates(qt)	0.36	0.26	-	-
Dry fodder (qt)	0.15	-	0.26	0.14
Green fodder (qt)			0.184	
Labor (man days)		0.27		
Miscellaneous (Birr)			0.157	0.18
Sample means (Birr)				
Concentrates(qt)	24.74	28.08		
Dry fodder (qt)	24.82		12.15	24.66
Green fodder (qt)			9.71	
Labor (man days)		136.65		
Miscellaneous (Birr)			114.27	228.89
Milk output (Liters)	2181.16	2484.83	493.57	639.1
Income from milk (Birr)	6543.48	7454.49	1480.71	1917.3
Marginal value products (MVPs) (Birr)				
Concentrates	96.66	67.91		
Dry fodder	40.21		31.69	10.88
Green fodder			28.06	
Labor		14.73		
Miscellaneous			2.07	1.51

N= Sample size
Note: qt= quintal

Comparison of MVPs of input factors with their respective costs

Production said to be efficiently organized under perfectly competitive condition in output and input relationship when MVPs are equal to their respective factor costs. To evaluate the efficiency of inputs and to perform comparison between MVPs and respective costs, the cost of the inputs have to be estimated on the bases of the nature of inputs and the price offered in the milk production process in the study area. For the purpose of testing the resource efficiency, the ratio of MVPs to input factor cost is computed and the results are presented in Table 4.22.

Table 4.22. Estimated ratio of marginal value product to factor cost

	Categories of farm size			
	Cross breed farms		Local breed farms	
Description	Medium size N=40	Small size N=45	Medium size N=30	Small size N=53
MVPs (Birr)				
Concentrate	96.66	67.91		
Dry fodder	40.21		31.69	10.80
Green fodder			28.06	
Labor		14.73		
Miscellaneous cost			2.07	1.51
Inputs cost (Birr)				
Concentrate /qt	178	178		
Dry fodder/qt	30		30	30
Green fodder/qt			25	
Labor/man day		5		
Miscellaneous cost			1.04	1.04
MVPs/ Inputs cost				
Concentrate	0.54	0.38		
Dry fodder	1.34		1.06	0.36
Green fodder			1.12	
Labor		2.95		
Miscellaneous			1.99	1.45

Source: Survey, 2010
N= Sample size

From the (Table 4.22) it is evident that, concentrate has higher MVPs to factor cost ratio for medium size cross breed farms than small size farms. For every additional one Birr incurred on concentrate, there is more than one Birr return in case of medium size and less than one Birr in case of small size cross breed farms in the study area. Dry fodder has highest MVPs against its price for medium size cross

breed, almost equal for medium size local breed farms and less than for small size local breed farms against its price. Therefore, this inputs needs to be increase in medium size cross breed and need to be decreased in small size local breed farms until the ratio of MVPs to factor cost reaches unity. Where as, for medium size local breed, the ratio is nearly unity. Green fodder has MVPs almost higher than its price. Thus, needs to be increased in medium size local breed farms.

With respect to labor input, the MVPs for small size cross breed farms are 14.73 Birr but the input cost of labor/man day is 5 Birr. That means the MVPs of these farms is more than the input cost of labor/man day. Therefore, this input needs adjustment in the production process. The MVPs of miscellaneous cost is double than its price Birr 1.04 for medium size and higher for small size local breeding farms. For every one Birr additional investment incurred on miscellaneous inputs there is more than one Birr (from 1.51 Birr to 2.07 Birr) return. Thus, computation of optimal levels of inputs becomes evident which will be applied by the various size groups of dairy farms in the study area.

4.4.5. Present and optimal levels of inputs

The results of Cobb-Douglas production function enable us to derive the optimum application of inputs for dairy farms in the study area. From the MVPs computed, it is possible to estimate the quantity of inputs with other inputs at mean level, required to cause productivity to equal to factor price.

The following formula is applied to determine the optimal input levels.

$$Px_i = \frac{bi}{x_i} y \text{ ---------- (11)}$$

$$X_i = \frac{b_i}{p_{xi}} y \text{ ----------(12)}$$

Where, y is the output estimated at the mean level of inputs (X_i), b_i is production function parameters, and P_i is the market price of the i^{th} input.

In equation 1, MVP is equated to market price of inputs, where satisfying the profit maximization criteria in perfectly competitive conditions of both output and inputs markets. Using equation 2, the optimum level of each input employed found to be significant in production functions were computed and presented in table 4.23.

Table 4.23.Present and optimum levels of inputs/cow

Description	Categories of farm size			
	Cross breed farms		Local breed farms	
	Medium size N=40	Small size N=45	Medium size N=30	Small size N=53
Present levels of inputs				
Concentrate /qt	24.37	28.54		
Dry fodder/qt	24.41		12.15	24.66
Green fodder/qt			9.71	
Labor/ man day		136.65		
Miscellaneous cost			114.27	228.89
Optimum levels of inputs				
Concentrate /qt	30.21	24.82		
Dry fodder/qt	32.70		12.84	8.88
Green fodder/qt			10.88	
Labor/ man day		403.12		
Miscellaneous cost			228.54	336.47

N= Sample size

The results of the computed optimum levels as compared to present levels of inputs shows that, the optimum level of inputs are increased by significant amount for the majority of inputs except for concentrate in small size cross breed and for dry fodder in small size local breed farms. The MVPs of optimum concentrate for medium size cross breed has changed from 96.66 Birr to 178 Birr and that of small size cross breed farms has changed from 67.91 Birr to 178 Birr. With respect to dry fodder, the MVPs for optimum dry fodder have changed from 40.21 Birr to 30 Birr for medium size cross breed, and 10.80 Birr to 30 Birr for small size local breed farms.

The MVPs of miscellaneous inputs has changed from 2.07 Birr to 1.04 Birr for medium size local breed farms and from 1.51 Birr to 1.04 Birr for small size local breed farms (Table 4.24).

Therefore the input changed for the variables at present level and optimum level is due to market price of the inputs. The present level of inputs is not efficient so farmers have to use the optimum level of inputs in order to get more profit.

Table 4.24. Marginal value products derived for inputs at their optimum level

	Categories of farm size			
	Cross breed farms		Local breed farms	
Description	Medium size N=40	Small size N=45	Medium size N=30	Small size N=53
Coefficients				
Concentrate	0.36	0.26		
Dry fodder	0.15		0.26	0.14
Green fodder			0.184	
Labor		0.27		
Miscellaneous cost			0.16	0.18
Optimum levels of Inputs / cow				
Concentrate /qt	30.74	24.82		
Dry fodder/qt	32.70		12.84	8.88
Green fodder/qt			10.88	
Labor/ man day		403.12		
Miscellaneous cost			228.54	336.47
MVPs/ Inputs cost / Birr				
Concentrate	178	178		
Dry fodder	30		30	30
Green fodder			25	
Labor		5		
Miscellaneous			1.04	1.04

N= Sample size

4.5. Farm Financial Efficiency and Profitability

The farm efficiency and profitability of the four categories of cross and local breed farms were assessed and comparisons were made among categories using cost-benefit and break- even analysis.

4.5.1. Cost-benefit analysis

Profitability level of local and cross breed dairy farms of both small and medium size groups were compared using cost-benefit ratio. Production cost, cost benefit ratio and return were computed for the four categories of farms separately and the overall results for local and cross breed farms were also assessed.

Production cost of dairy farms

The production cost of dairy farm considered comprises of variable and fixed costs. The variable cost of inputs analyzed included cost of concentrates, green fodder, dry fodder (hay, straw and aftermath), labor, medicine and veterinary service, interest on working capital and miscellaneous cost. Fixed costs included were depreciation costs of animals, building and dairy equipments as well as interest on fixed capital.

The overall production cost of cross breed farms per year was Birr 17,005 per farm and that of local breed farms was 5,142 Birr. The average prodduction cost of cross breed farms per cow per year was Birr 5,690 and that of local breed farms per cow per year was Birr 2,211. From this, local breed farms are efficient in input use as it is stated in the hypothesis than cross breed farms. Out of this variable costs accounted for 83% (Birr 14,042) and fixed cost accounted for 17% (Birr 2963) of total cost of production. The proportional of variable and fixed costs for small size cross breed farm was 85% and 15% and that of medium size crossbreed farm was 79% and 21%, respectively (Table 4.25).

The total production costs of local breed owning medium and small size farms were Birr 7,144 and Birr 4,009 per farm, respectively. For medium size local breed owning farms, variable cost accounted for 85% (Birr 6,108) and fixed cost accounted for 15% (Birr 1,036). In case of small size farms the variable cost accounted for 90% (Birr 3,605) and fixed cost accounts for 10% (Birr 404) of the average total production cost. Variable cost was a bit higher (5%) and fixed cost was also a bit lower (about 5%) for small size farms as compared to medium size of both cross breed and local breed cow owner farms. This means that small size

cross breed and local breed cow owning farms incurred 5% more cost on variable inputs but 5% less cost on fixed items in the production. The fixed cost is different mainly because of herd size and fixed investment associated to the size of the farms. One important reason for the low variable cost is the variability nature of the items with the herd size, as the herd size increases the amount of inputs incurred for some of the items do not make a significant increase. The share of fixed cost is lower as compared to variable cost (Table 4.25). The expenditure on variable cost was 79% and 85% for medium size cross and local breed owning farms, respectively. Variable cost was 85% for cross breed and 90% for local breed owning small size farms. Both cross breed and local breed owning small size farms spent about 5% more on variable cost than medium size farms because cost of variable items decrease as the herd size increase or the amount of some variable inputs used do not have a significant difference between small and medium size farms. Efficiency of the farms in the utilization of the cost items increases as herd size increases. Accordingly, fixed cost was 21% and 15% for medium size cross breed and local breed owning farms, respectively. On the other hand, fixed cost was 15% and 10% for small size cross breed and local breed owning farms, respectively. The ratio of fixed cost from the total cost is higher in medium size than small size of both farm types this is because fixed cost is generally related to fixed assets that increase as a farm size increases.

The overall share of variable and fixed costs were nearly in line with study done by Kalra et al.(2005) on economics of milk production and disposal in rural areas of Harayana, India. They reported that, the share of fixed and variable costs were approximately 85% and 15%, respectively. The findings were also in agreement with similar studies by Alam et al. (2007) on the economics of dairy farms in selected areas of Bangladesh. Alam et al. (2007) reported that the share of variable and fixed costs were 87% and 13%, respectively. However, the results of this study were not in agreement with the study done by Bordoloi et al. (2006) on milk production under different categories of farms in India. They reported that the share of variable and fixed costs were 91.39% and 8.61%, respectively.

An examination of costs of cross breed farms, shows that, cost of concentrates was the major cost accounting for 39% (Birr 6,715), followed by dry fodder accounting for 16% (Birr 2,645), labor cost accounting for 11% (Birr 1,875), depreciation of cows accounting for 8% (Birr 1,406), miscellaneous cost accounting for Birr 10% (Birr 1,697), depreciation of cows shed accounting for 5% (Birr 775), interest on fixed capital accounting for 4% (Birr 668), green feeds accounting for 4% (Birr 621), interest on working capital accounting for 3% (Birr 488), medicine and veterinary services accounting for 1% (Birr 212) and depreciation of equipments and others accounting for 1% (Birr 114).

The leading share of concentrate cost for cross breed farms was in agreement with similar study done by Kalra et al. (2005) and Alam et al. (2007) on small, medium and large size farms. They reported that concentrate was the major cost item. However, the rank and share of the remaining cost items were not in agreement with the results of this study. Moreover, the finings were not in agreement with study done by Sayeed et al. (2004) on economics of dairy farms in Bangladesh on 48 cross breed of large, medium and small size farms. Sayeed et al. (2004) reported that labor was the major cost followed by concentrates. Majority of cross breed farms used concentrates especially bran as main inputs in milk production and dry fodder (hay and aftermaths) as a main source of fodder than green fodder because farmers don't have land for fodder production. The depreciation of cows is the fourth important cost item because of the higher amortization value of cows in the study area.

Concentrate, dry fodder, labor, depreciation of value of cows and miscellaneous costs accounted for the major components of production cost, with the same order of importance for the medium and small size cross breed farms. However, cost of green feed shows that green feed is relatively more utilized by small size farms than medium size cross breed dairy owning farms in Mekelle. Except for this, the costs follow the same order of importance for small and medium size cross breed farms (Table 4.25). In both small and medium size farms that owned local breed cows, cost of concentrate constituted the highest cost of production (i.e., 31% and 21% for small and medium size, respectively) followed by costs of dry fodder, labor and green feed.

Miscellaneous costs ranked fifth for small size. The share of concentrate from the total production cost for local breed farms was in agreement with similar study done by Alam, et al. (2007) who reported that concentrate was the major and leading cost item. Also, Kalra et al. (2005) reported that concentrate followed by dry fodder were the major cost items for local breed farms. The remaining cost items followed concentrate and dry fodder reported by them were not in agreement with the results of this study. Similarly, the rank and share of cost items for local breed owner farms indicated in this study were not in agreement with the study done by Sayeed et al.(2004) who reported that labor charge had the highest share (55.87%) followed by dry fodder (17.9%) and concentrates(13%). The overall average fixed cost share for local breed owning farms are almost in agreement with study done by Alam et al. (2007).

Concerning cost of interest on working capital, depreciation of cows shed and equipments as well as interest on fixed cost accounted only 10% of the total production cost.

Concentrate, dry fodder, labor, depreciation value of cow, and miscellaneous costs accounted for over 83% of the total cost for cross breed farms. Thus over 90% of the total production cost of local breed farms was accounted by concentrate, dry fodder, green fodder, labor, miscellaneous costs, interest on operating capital and depreciation of Value of cows, among of which concentrate, dry fodder, labor and green fodder accounting for over 75% of the production cost. One peculiar difference between local and cross breed farms was the fact that green fodder accounted for a significant share from the total production cost of local breed owning farms than cross breed owning farms. Green fodder accounted 10% of the total production cost of local breed owning farms, where as it is 4% of the costs of cross breed owning farms. This is because local breed owners were resides at the boarder side of the town relatively nearer to the neighboring rural farmers may have access to green feed.

Input annual average cost/ cow (Birr)

The over all average cost of concentrates for cross breed per cow is Birr 2247 and that of local breed is Birr 573. The over all average cost of Dry fodder for cross breed per cow is Birr 885 and that of local breed is Birr 467. The over all average cost of Green fodder per cow is Birr 207 and Birr 264 for cross breed and local breed respectively. And the over all average cost of labor per cow is Birr 627 and Birr 418 for cross breed and local breed respectively.

The over all input cost of cross breed per cow is Birr 3967 and that of the local breed is Birr 1722. Therefore this indicates, cross breed farms take the highest input use than local breed farms. So it is advisable for the farmers to use their own farm land for grazing animals and have some of the inputs like green fodder and dry fodder of their own. The Government should also give attention for the farm owners to get these inputs with affordable price.

Table 4.25. Annual production cost of a dairy farm (Birr)

Cost items	Categories of farms					
	Cross breed			Local breed		
	Small	Medium	Overall	Small	Medium	Overall
Variable cost						
Concentrates	3790 (39)	8210 (38)	6715 (39)	1226 (31)	1521 (21)	1333 (26)
Dry Fodder	1704 (18)	3260 (15)	2645 (16)	848 (21)	1507 (21)	1086 (21)
Green Fodder	468 (5)	793 (4)	621 (4)	400 (10)	994 (14)	615 (12)
Labor	1120 (12)	2229 (10)	1875 (11)	734 (18)	1393 (20)	972 (19)
Miscellaneous costs	869 (9)	2021 (9)	1697 (10)	291 (7)	515 (7)	372 (7)
Interest on operating Capital	238.52 (2)	495 (2)	488 (3)	105 (3)	178 (2)	131 (3)
Total variable Cost	8190 (85)	17007 (79)	14042 (83)	3605 (90)	6108 (85)	4510 (88)
Fixed cost						
Depreciation of Cows shed	321 (3)	1287 (6)	775 (5)	148 (4)	209 (3)	170 (3)
Depreciation of Cows	765 (8)	2126 (10)	1406 (8)	154 (4)	470 (7)	268 (5)
Depreciation of equipments	61 (0.63)	174 (0.80)	114 (0.67)	11 (0.27)	121 (1.69)	51 (0.98)
Interest on Fixed cost	333 (3)	1044 (5)	668 (4)	92 (2)	236 (3)	144 (3)
Total fixed Cost	1479 (15)	4631.50 (21)	2963 (17)	404 (10)	1036 (14.51)	632.50 (12)
Total production cost	9670	21639	17005	4009	7144	5142

Figures in parenthesis are percents

Returns from dairy farms

Revenue from dairy farms estimated considering milk sold and con sumed milk, sales of cattle, appreciation of cattle (i.e., calves heifers and young bull), sold and used cow dung and manure. Return to small and medium size of local and cross breed farms were estimated. On average milk price received by owners of all farm categories is Birr 6 per liter.

Table 4.26. Annual return (Birr) and C:B ratio of a dairy Farm

Return Components	Category of farms					
	Cross breed			Local breed		
	Small	Medium	Overall	Small	Medium	Overall
Milk (Birr)	25532	64182	43720	4568	12724	9200
	(96)	(86)	(85)	(81)	(81)	(81)
Sale of Cattle (Birr)	252	1603	888	55	207	110
	(1)	(2)	(2)	(1)	(1)	(1)
Appreciation of Calves and Heifer (Birr)	378	8803	6460	774	2465	1630
	(1)	(12)	(13)	(14)	(16)	(15)
Dung and manure (Birr)	352	234	291	248	314	291
	(1)	(0.3)	(1)	(4)	(2)	(3)
Gross return (Birr)	26514	74822	51359	5675	15710	11231
Gross margin (Birr)	18324	57815	34354	2070	9602	6721
Net return (Birr)	16844	53183	34354	1666	8566	6089
C:B (on total cost)	1.0:2.74	1.0:3.45	1.0:3.02	1.0:1.41	1.0:2.19	1.0:2.18

Figures in parenthesis are percents

The highest share of total returns for the categories of cross breed farms was from milk and milk by product sales (85%) followed by appreciation of calves and heifers (13%), sales of cattle (2%) and cow dung (1%).

Sale of cattle contributed relatively more to the total revenue than cow dung for medium size farms because cow dung relatively incurred cost to dispose. Cow dung generates income for the majority of small size farms, since it is used as a source of fuel and

manure. (Table 4.26).

The highest share of total returns for all categories of local breed farms was from milk and milk by products (81%), then appreciation of calves and heifers (15%) followed by cow dung (3%), and sale of cattle (1%). The majorities of small size farms household are poor and resides at the periphery of the town, and used cow dung as sources of fuel and manure as compared to medium size farms (Table 4.26).

Share of return from cross breed and local breed owning farms are almost in agreement with similar study done by Sadiq et al. (2006) in India. He reported that milk constituted the highest share (71%) followed by appreciation of calves and heifers (21%) Alam et al. (2007) also reported return from milk constituted the highest share (69.43%).

Gross margin were Birr 18,324 and Birr 57,815 for small and medium size of cross breed owning farms. Gross margin were Birr 2,070 and Birr 9,602 for local breed owning small and medium size farms, respectively. The gross return is higher for medium size, cross breed and local breed owning farms. On average a local breed owning farm earned a net return of Birr 6,089 per annum. Cross breed owning farm generated a net return of Birr 34,354 per year that was almost five folds greater than net return from local breed owning farm. The net return of local breed per cow per year is Birr 2,619 and that of cross breed is Birr 11,496. The net benefit increased as farm size increases both for cross breed and local breed owning farms. These results are almost in agreement with similar study done by Reijo (2007) in Northern Shewa, Sellalie area in Ethiopia. They reported gross margin of cross breed was higher than local breed cows. Alam et al. (2005) also reported similar result that, medium size farms had higher gross margin than small size farms for both cross and local breed owning farms. However, this study results are not in agreement with the results reported by Chand et al. (2002) that gross margin of small size farms were highest (70%) than medium size farms (64%).

Overall cost-benefit (C:B) ratio of cross breed farm was 1:3.02. For local breed farms, the cost- benefit ratio was 1.00:2.18. The calculated average cost-benefit ratio (C:B) was 1:2.74 and 1.0:3.45 for small and medium size cross breed farms, and it was 1.00:1.41 and 1: 2.19 for small and medium size local breed farms, respectively. These results in general indicated that, both cross breed and local breed dairy farms are

profitable at Mekell (Table 4.26). Cross breed medium size farms are making more profit than small size cross breed cows owning farm. And local breed medium size farms are more profitable than small size local breed farms.

These results were in agreement with similar studies done by Sayeed et al. (2004) that reported the overall C:B ratio of cross breed is highest (1:1.34) than local breed cows (1:1.04) and medium size farms are profitable with C:B ratio of 1:1.37 for cross breed and 1:1.03 than small size farms with C:B ratio of 1:1.09 and 1:0.93 of medium and small size, respectively. There fore the first null hypothesis is accepted accoding to these data. Also, Alam et al. (2005) reported similar results that medium size farms had highest C:B ratio (1:1.04) than small size farms (1:1.02).

4.5.2. Break-even analysis

The break-even level of output is an output level required to cover the fixed cost employed in the farm. It is estimated for all categories of cross breed and local breed farms and the results presented in Table 4.27. The overall break-even average point for cross breed farms showed that the farm produced 2292 liters of milk per cow per year with a fixed cost of Birr 1,219 and variable cost of Birr 4,129 per cow per year that was amounted to Birr 1.8 of variable cost and Birr 6 price of a liter of milk, the break-even output was 290 liters per cow per year, which was 13% of the average actual milk yield of a farm per year. Similarly, for local breed farms a cow producing an average of 573 liters of milk per cow per year with fixed cost of Birr 273 per cow per year and variable cost of Birr 1,944 per cow per year, the break-even output was 104 liters per cow per year.

Accordingly, the break-even output estimated was 212 and 246 liters per cow per year for small and medium size cross breed farms. The small size farms owners were able to cover their fixed cost at lower milk production than medium size farms. The break-even output estimated for local breed farms were 203 and 75 liters of milk per cow per year for small and medium size. The break-even output results of local breed farms indicated that both farms were relatively inefficient than cross breed. Small size cross breed farms were at better position and

efficient as compared to medium size cross breed farms, as they needed only 8% of the average milk yield to cover their fixed costs than medium size farms (11%) (Table 4.27).

As the estimated data in table 4.27, the cross breed farms are relatively efficient to cover their fixed cost than local breed farms. So it is preferable for the farmers to have cross breed cows than local breed because of high milk production. Or in other words it is good to the farms to transform local breed cows' to cross breed cows.

Table 4.27. Break-even level of milk production across category of farms

Items	Farm types and categories					
	Cross breed			Local breed		
	Small N=45	Medium N=40	Overall N=85	Small N=53	Medium N=30	Overall N=83
Milk yield/ farm/year (liter)	4387	9620	6850	818	2168	1306
Milk yield /cow/year (liter)	2598	2162	2292	647	533	573
Fixed cost/ cow/year(Birr)	876	1041	1219	321	247	273
Variable cost/ cow /year (Birr)	4850	3822	4129	2861	1454	1944
Total cost/ cow/ year (Birr)	5726	4863	5348	3181	1701	2216
Variable cost/ liter of milk (Birr)	1.87	1.77	1.8	4.42	2.73	3.39
Price/ liter of milk (Birr)	6	6	6	6	6	6
Break-even out put / cow/ year (Liter)	212	246	290	203	75	104
% Of break-even milk output to total milk output	8	11	13	31	14	18

N=Sample size

4.6. Challenge to dairy farms

Credit is available almost all the time, however the loan repayment period is short and the interest rate is high which is discouraging in availing credit.

The cost and availability of breed are the major problems. The average cost of breed cow is around 10,000 Birr which is beyond the capacity of many; even if one can afford they are not available in the area they have to bring them from places like Addis Ababa.

Lack of feed and its cost is one major problem that may threaten the very existence of the Dairy farms. There is shortage of rain fall which results in poor grazing land. In addition Dairy farmer's attempts to grow quality feed such as Alfa-Alfa, Lucinea, Suspenea have been aborted by the lack of water. In the market the quality feed mentioned are not available and farms shift to buy poor quality fodder which has a negative bearing on the milk yield of the cows. They also have shortage of land to plant quality feed. The other challenge is the none - availability of Veterinary services at all times, particularly during the weekends and holyday.

Poorly developed infrastructure particularly roads are major challenge, in this area feed has to be brought in and product has to be taken mostly on foot and some times on donkey and horse carts. This exposes them to unnecessary expenses and loss of time as well as energy.

Lack of electric power has limited capacity to store their products and the lack of telecommunications is also a serious problem for marketing transaction with in these cases has to be done in person. There are no organized and established markets for milk and milk products , there are no milk processing plants, the product is sold directly to consumers like cafeterias, hotels and house holds. The other main problem here is that there is long Christian fasting period accounting for almost 51% of a year during this time milk and other animal products are not consumed by the followers. During this period there is

wastage of milk. From the problems stated above feed price and the long fasting period are the main once (Reported by: Mekelle Bureau of Agriculture, 2010).

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary

Ethiopia has the largest livestock population in Africa. But the contribution of this resource to the economy is limited and yet the country is in poverty. Demand for dairy products seems to exceed supply in the country in general and the study area in particular. Therefore, dairy development has a big role for the contribution of income generation and employment purpose. Hence, the situation of dairy production and marketing issues in Mekelle is needed to discuss and analyzed. In this study an attempt has been made to evaluate the efficiency of use of inputs, assess profitability and analyze the efficiency differentials of modern (cross breed) and traditional (local breed) dairy farms. A total of 168 farms (50% of the total dairy farms in Mekelle) were sampled proportionately from cross breed and local breed. Accordingly, 85 cross breed farms (40 farms from medium size and 45 farms from small size) and 83 local breed farms (30 farms from medium and 53 farms from small size) sample were selected for the study.

The households them selves were the respondents. Therefore, the analysis and interpretation of the data results are followed accordingly.

From the total farms surveyed (168), 75 percent are male-headed households while 25 percent are female-headed households. In general, female-headed household farm owned cross beed and local breed farms were few as compared to farms owned by male-headed household. The shares of illiterate read and write and 1- 6th grade are larger in local breed farm owners than cross breed farm owners. Where as, the share of diploma holders are larger in cross breed farm owners (16%) than local breed farm owners (8%). Both hired and family labors were used in the study area in dairy farming activities. The majority of local breed farm owners' households (77%) used family labors and that of cross breed dairy farms owners (73%) used hired labors. As the survey indicates most dairy farmers do not take dairying as sole career rather they take it as supplementary job to get additional income. The main reason that the households motivate for investing in dairy farming is that because they would earn better life. Most of the dairy farms are

not using grazing system. As a consequence 90% of the households purchase and feed their cattle. 80 percent of the respondents have reached that the price of animal feed is too expensive.

Cobb-Douglas production function was applied to evaluate the resource use efficiency from the computed MVPs, MVPs to factor cost ratio and optimum levels of inputs. Prior to that, the log value of the dependent and independent variables were fitted to multicollinearity test to observe the correlation between variables. There is no severe correlation between variables that were considered in the production function.

The parameters of the Cobb-Douglas production function, regression coefficients and associated values of standard error, t-value as well as the adjusted $R^2$and F-value were computed for the four size categories of farms. The adjusted R^2 for medium and small local breed farms indicates that 57% and 47% of the variations in milk production explained by explanatory variables included in the production function, respectively. Whereas, the results are 49% and 52% for medium and small cross breed farms, respectively.

The regression coefficients for concentrate are positive and significant at 10% and 5% level for medium and small size cross breed farms, respectively. The coefficients for dry fodder are positive and significant at 10% level for medium size cross and local breed farms and significant at 5% level for small size local breed farms.

Regarding the coefficients for labor, it is positive and significant at 5% level for small size cross breed farms, where as, negative and insignificant for medium size cross breed farms.

The coefficients for miscellaneous cost are positive and significant at 10% level for medium and small size local breed farms and negative and insignificant for small size cross breed farms. For green fodder the coefficients are positive and significant at 5% level for medium size while negative and insignificant for small

size local breed level farms. With respect to the coefficients for stage of lactation, they are positive and insignificant for all farm size categories, except it is negative and insignificant for small size local breed farms.

The sum of regression coefficients (elasticities) for medium and small size cross breed farms is 0.62 and 0.85, respectively. For medium and small size local breed, the sum of the regression coefficients is 0.77 and 0.36, respectively. For a 100% equal increase of all inputs, in the respective farm size; the milk output would increase by 62% and 85% for medium and small size cross breed farms, respectively, while the increases are 77% and 36% for medium and small size local breed farms, respectively. Here some factors of production may be inefficient and less productive. And, the coefficients of input in the production function are negative.

The MVPs computed for significant inputs shows that, for concentrate 96.66 Birr and 67.91 Birr for medium and small size cross breed farms. The MVPs for dry fodder, the values are 40.21 Birr, 31.69 Birr and 10.88 Birr for medium size cross breed, medium size and small size local breed farms, respectively. Green fodder and labor have a MVPs of 28.06 Birr and 14.73 Birr for medium size local breed farms and small size cross breed farms, respectively. Regarding the MVPs values for miscellaneous cost 2.07 Birr and 1.51 Birr for medium and small size local breed farms, respectively.

The optimum levels of inputs are different than the present levels of inputs for all categories of farms. The MVPs computed for optimum level of inputs in all categories of the inputs increased except for concentrate and dry fodder in small size cross breed and local breed, respectively.

Cost-benefit and break-even analysis were employed to assess the profitability and financial efficiency differential of medium and small size cross breed and local breed cows owning farms. The overall production cost of cross breed farms per year was Birr 17,005 per farm and that of local breed farms was 5,142 Birr. The average production cost of cross breed farms per cow per year was Birr 5,690 and that of local breed farms per cow per year was Birr 2,211. From this, local breed

farms are efficient in input use. The share of variable and fixed costs of the overall observation for cross breed farms were 83% and 17% of the total production cost, respectively. Accordingly, the share of variable and fixed costs for medium size cross breed owner were 79% and 21% of the total cost of production and 85% and 15% of the total cost of production for small size, respectively. The share of variable and fixed cost for medium and small size local breed owner farms were 85% and 15% of the total cost of production, for medium size and 90% and 10% of the total cost of production for small size, respectively. The share of variable cost was much higher than fixed cost in all categories of farms. The share of variable cost was by much greater and fixed cost lower for small size farm than medium sizes farms both for cross breed and local breed farms.

Concentrates was the major input with the highest cost share for all breeds and categories of farms and accounts for 39% and 26% of the total cost of production for cross breed and local breed owning farms, respectively. Similarly, cost of concentrate accounts for the highest share of the total variable costs followed by dry fodder and labor for medium and small size cross breed and local breed cows owning farms.

The highest share of annual return was from sale of milk, followed by appreciation of calves and heifers. The share of milk for cross breed farms was 85 percent (43,720 Birr) and that of local breed was 81 percent (9,200 Birr). The share of appreciation of calves and heifers for cross breed was 13 percent and that of local breed farms was 15 percent. Similarly the share of sell of milk and appreciation of calves and heifers from components of return had similar trend for small and medium size cross breed and local breed cows owning farms. Cow dung contributes 2% and 4% of the total return for medium and small size local breed farm groups, respectively. The net return of local breed per cow per year was Birr 2,619 and that of cross breed was Birr 11,496.

Moreover, cost-benefit ratio was employed to assess the profitability of the dairy farms and differences among farms. The overall C:B ratio on total cost were 1 : 3.02 for cross breed and 1 : 2.18 for local breed cows owning farms in Mekelle town. The C:B ratio on total cost for medium and small size of cross breed cows

owning farms were 1 : 3.45 and 1 : 2.74, respectively. These results show that small and medium size cross breed cows owning farms have higher cost-benefit ratio than local breed medium and small size farms. Cross breed medium size farms are making more profit than small size cross breed cows owning farm. For one Birr additional investment return from milk would be 3.45 Birr and 2.74 Birr for medium and small size cross breed farm groups, respectively. The C:B ratios for medium and small size local breed farms were 1:2.19 and 1:1.41 respectively. For one Birr additional investment, return from milk would be 2.19 Birr and 1.41 Birr for medium and small size local breed cows owning farms indicating that medium size farms are more profitable than small size farms.

The average cross breed farms produced 2292 liters of milk per cow per year and that of local breed farms a cow producing an average of 573 liters of milk per year. The break-even output for cross breed farms was 290 liters per cow per year and the break-even output for local breed farms was 104 liters per cow per year.

5.2. Conclusions

It is already indicated that the intention of the study is to undertake the situational analysis of milk production in Mekelle, with due consideration to its problems and prospects.

Empirical experiences proved that the goals of milk production are not the same in the rural and urban areas. The latter is exclusively market oriented, be it at a household level or in the modern farms. However, whether the sector progresses in accordance to the pace of urbanization is under big question.

- Dairy production systems are of different varieties among which market oriented small holders and modern production systems are peculiar features to the urban centers. Research also proved that mixed farming system, which is dominant in the rural areas, also exists in the peri- urban areas of Mekelle.
- Dairying is considered as a supplementary job for the majority of the dairy farmers in Mekelle.
- Farmers in both cases (small holders and modern) use different varieties of feed sources mainly agricultural products. However, the farmers entirely apply ***zero grazing system***, which is expensive to attain it. The price of feed is too sour in

Mekelle since it is drought prone area and the limited nature of agro processing industries that could supply industrial bi-products as source of animal feed.

- Except in the modern dairy farms there are very limited numbers of farmers among the house holds who employ wage laborers. Otherwise the majority of the house holds use family labor
- The average amount milk produced by an exotic/cross breed type is about 10 litters though there are cows that give even more that 10 litters per day.
- The Christian fasting is a serious problem of market for liquid milk since the shelf life of milk is short.
- The existing market outlets in the city are: household customers, retailers and institutions. And more than 90% of the milk produced by the modern dairy farms is sold on contract basis particularly that of Kelamino.
- Due to the high cost of animal feed the producers are not happy with the prevailing market price. Therefore, most of the household producers are proposing a new price of birr 7.50 – 8.00.

The foregoing analysis of production function indicates that concentrate is the most important inputs affecting milk production in the study area. The regression coefficients of this input were positive and statistically significant especially, for cross breed cows owning farms with higher MVPs as compared to other inputs indicating that farmers can increase their milk output by feeding more concentrate to the animals on both categories farms. The regression coefficients of dry fodder were also positive and significant mainly in local breed cows owning farms of both farm sizes. These results indicate the possibility of diverting part of capital from significant inputs to concentrate and dry fodder. This can be supported by the highest share of the total cost accounts for concentrate, followed by dry fodder in all farms size categories of cross and local breed farms. Based on the findings, the following general conclusions are drawn:

1. The utilization of inputs should be adjusted to the optimal level until the MVPs equate the factor price of the respective inputs. In this regard, the present level of concentrate needs to increase from 24.37 quintals/ cow to 30.21 quintals/ cow and decreased from 28.54 quintals/cow to 24.82

quintals/cow for medium and small size cross breed cows owning farms, respectively

2. The quantity of dry fodder presently used has to be increased from 24.41 quintals /cow to 32.70 quintals /cow and reduced from 24.66 quintals /cow to 8.88 quintals /cow for medium size cross breed and small size local breed cows owning farms.

3. Green fodder has to be increased from 9.71 quintals /cow to 10.88 quintals /cow for medium size local breed cows owning farms.

4. The utilization of labor should be increased from 136.65 man days/cow to 403.12 man days/cow for small size cross breed farms

5. The utilization of miscellaneous inputs should be increased by increasing the cost incurred for their purchased in medium and small size local breed cows owing farms.

6. Cross breed cows owning farms are profitable and efficient with higher benefit over cost and lower ratio of break-even output from actual milk production than local breed cows owning farms. Similarly, medium size is profitable than small size farms.

7. Concentrate cost has the highest share from the total cost of production followed by dry and green fodder in dairy farming. Therefore, due attention should be given for their availability and accessibility.

8. The average production cost of cross breed farms per cow per year was Birr 5,690 and that of local breed farms per cow per year was Birr 2,211. From this, local breed farms are efficient in input use than cross breed farms.

5.3. Recommendations

- Transforming local breed cows farms to cross breed cows farms because Cross breed cows are profitable and efficient with higher benefit over cost and lower ratio of break-even output from actual milk production than local breed cows.

- Medium size is profitable than small size farms. Therefore, it is better for the dairy farm business to increase the herd size above three.

- Farm owners have to be encouraged and advisory services (health of animal service, Education service) should be promoted through agriculture offices on how to increase their production.

- Feed and feeding is the major cost aspect of the dairy farmers specially that of concentrate. Therefore, dairy farm owners should have their own farm land to grow animals feed and they should be encouraged to establish linkage with near by out growers. Moreover, out growers should be also encouraged to involve in fodder development activities. For these effects, the research institution, Mekelle town and the surrounding woreda Agriculture and Rural Development Offices should work jointly in promoting and extending fodder development and marketing in the area.

- Government or other concerned body should establish animal feed processing factory that could improve the shortage.
- Dairy cooperatives could play a big role by supplying all the necessary inputs including animal feed at normal price.
- Introducing milk-processing factories that could mainly resolve the market problem of the milk producers since the shelf life of milk is short.
- Providing the farmers with extension and training services.
- Relatively cross breed farm owners should be educated than local breed farm owners because cross breed cows are more sensitive and they need more treatment than local breed cows.
- Dairy farmers should take dairying as sole career in order to earn better life.

BIBLIOGRAPHY

Amha Kasahun, 2008.An Integrated Urban, Peri-Urban and Rural Dairy Development Program in Tigray.Draft Document Livestock Development Consulting Group. REST, Mekelle.

Aitawade, M.S., K.R.Waykar and H.R. Shinde, 2005. Economics of Milk Production from Cross breed Cows in Akola District of Maharashtra State. Indian Dairyman. 57 (1): 48-52.

Anthony, I., M.B. Anke, Girma Abebe and A.V. Zarate, 2006. Comparison of Urban and Peri-urban Dairy in Hawassa, Ethiopia. Deutscher, Tropentag, Berlin

Bonnier Puck, 2006.Dairy Cattle Husbandry. A.J Wageningen, the Netherlands.

Brokken F. Ray and Senait Seyoum, 2006. Dairy Marketing in Sub-Saharan Africa. ILCA, Addis Ababa, Ethiopia.

BoARD Tigray Region. 2004, Regional Annual Report. Mekelle, Tigray.

BoFED Tigray Region. 1998. Socioeconomic Survey on Livelihood of Rural people in Eastern Tigray, Mekelle, Tigray.

CSA (Central Statistics Authority), 2004.The 2004 Population and Housing Census of Ethiopia.

CSA (Central Statistics Authority), 2003. Household crop and livestock production Survey Report.

Debrah Siegfried and Berhanu Anteneh, 2007. Dairy Production in Sub-Saharan Africa. ILCA, Addis Ababa, Ethiopia.

Ehui. S, 2008. Livestock Policy Analysis: The Role of Livestock in Food Security. New York, McGraw.

G.Halcrow Harold, 2007. Agricultural Policy Analysis. New York, McGraw.

G.Mbogoh Stephen and Negusie Tilahun, 2006. Relative Efficiency of Alternative Dairy Marketing Systems in Addis Ababa. ILCA, Addis Ababa, Ethiopia.

Getachew Felleke and Gashaw Geda, 2006. The Ethiopian Dairy Development Policy: A Draft Policy Document, Ministry of Agriculture. Addis Ababa, Ethiopia.

Gujarati, N.D., 2003. Basic Econometrics. 4th Edition, U.S. Military Academy West point, New York, N.Y, U.S.A. pp 377-392

Dairy Development and Internal Dairy Marketing in Sub-Saharan Africa. ILCA, Addis Ababa, Ethiopia.

Haile Hagos, 2007. Sectoral Analysis of the Ethiopian Economy (Policy Issues, Strategies and Performance. Addis Ababa , Ethiopia.

Hailu Gebru(Dr.) (nd.).The Kalamino Dairy Farm: A Model Farm For Dairy Development Intervention in Tigray.TDA, Mekelle, Tigray.

Himanen Auli and Azage Tegegne,2007. " A Proposal for Establishment of a National Milk Recording and Herd Registration Scheme in Ethiopia", Smaller Dairy Development Project.Addis Ababa, Ethiopia.

Heady, E.O., and J. L. Dillon, 2004. Agricultural Production Functions, USA, Iowa State University press, Ames, pp.73, 75-76, 97-98,197

Holloway, G., Nicholson, C., Delgado, C., Staal, S. and S. Ehui, 2005. How to Make a Milk Market: A case Study from the Ethiopia Highlands. Socio-Economic and Policy Research Working Paper 28. International Livestock Research Institute. Addis Ababa, Ethiopia.

Kebede Mammo, 2006. "Urban Development in Ethiopia". Addis Ababa, Ethiopia.

Kotler. P. 2003. Marketing Management. Delhi-India.

M.Heinonen, 2008. Artificial Insemination in Ethiopia. ILCA. Addis Ababa, Ethiopia.

Mehret Ayenew,2006."Poverty and Urban Government Institutions', ed. Desalegn Rahmewto ,Some aspects of Poverty in Ethiopia. Forum for Social Studies, Addis Ababa.

Mekelle City Administration, 2005/06. Mekelle City Strategic Plan, 2005-2007. Mekelle, Tigray.

Mekelle Municipality, 2003. Mekelle City Profile (Unpublished Document), Mekelle, Tigray.

MEDaC Agriculture Development Department, Muriuki, H.G. and W.Thorpe. 2001. Smallholder dairy production and marketing in Eastern and Southern Africa. In the proceedings of the South. South workshop on smallholder Dairy production and Marketing. Constraints and Opportunities. March 12.16. Annand, India.

Mian, M.R.U., M.A. Halim and M.A. Jabbar, 2005. Economics of Dairy Farming under Livestock Credit Program of BKB in a Selected Area of Mymensingh District Bangladesh Journal of Training and Development. 14(1/2): 89-98

Mohamed A.M., S.K. Ehui and Yemesrach Assefa, 2007. Dairy Development in Ethiopia, Conference paper No.6. International Livestock Research Institute, Addis Ababa, Ethiopia.

Reijo Ojala, 1998. Gross margin and production cost calculations of milk production at Different production and Management Levels Smallholder Dairy Development Project (SDDP), Addis Ababa, Ethiopia.

Singh Katar, 1986. Rural Development: Principles, Policies and Management, 2nd ed. New Delhi.

Saadallah, M, 2005. Smallholder Dairy production and Marketing in Bangladesh Department of Animal Science Bangladesh Agriculture University. Mymensingh, Bangladesh.http//www.ilri.cgiar.org/infosen/webpub/Fulldoc=/south-south/htm

Sadiq, G., I. Muhammad and S.H. Saddozai, 2006. Estimation of Cost and Revenue and Analysis of the Different Factors Affecting Livestock Production, Sarhad Journal of Agriculture. 19(4):579-584

Sayeed, M.A., S. M. A. Rahaman, J. Alam, and J. Begum, 2005. Economics of Milk Production in Dhaka District. 7 (1): 49-55

Tigray Bureau of Agriculture, 2008. Regional Strategy of Livestock Resource Development.

W. Mathewman Richard,2007.Dairying, ed. Coste Rene, The Tropical Agriculturist. University of Edinburgh, Scotland.

Wilson R. Trevor, 1995.Livestock Production Systems, ed. Coste Rene, The Tropical Agriculturalist. University of Edinburgh, MacMillan Education Ltd London and Oxford.

Walsh M.J.,J. Grindle,A. Nell, and M.Bachann,1991. Dairy development in sub-sahara Africa: A study of issues and options. World Bank Technical paper 135. The world Bank, Washington, DC, USA.94p

APPENDICES

APPENDIX I. The Procedure Used to Estimate Cost and Return

Appendix 1. The procedure used to estimate the cost and return of dairy farms

i. **Variable cost:** The following variable costs were computed for each of the sampled farms.

a) **Feed cost:** feed cost included cost of concentrate, straw, green fodder home produced and purchased hay. The cost of home produced feed was calculated using farm-get price and the value of purchased feeds was estimated at prevailing market prices separately for each item.

b) **Labor cost**: Both family labor and hired labor (casual and permanent) was considered. The family and hired labor was valued at prevailing wage rate (five Birr per man-days) and actual payment.

c) **Veterinary and insemination service cost:** This cost line included value of medicines, vaccines and fees actually paid to veterinary specialists, which included the cost of artificial insemination and technician cost and bull service.

d) **Transportation cost:** It included carrying cost of feeds and marketing cost of cattle, milk and milk by products as well as, disposal cost of cow dung

e) **Electricity Cost:** Electric power used for milk production and processing in dairy farm based on the bill from authorized agency. It also include dry battery cost

f) **Fuel Cost:** Cost incurred for fuel

g) **Water Cost:** water consumed by the dairy farm for milk production and processing

h) **Maintenance cost:** This included cost incurred for maintaining fixed assets and equipments.

i) **Tax and rent cost:** tax paid in the business and cost paid for rent in items (may be land, Equipments, etc)

j) **Stationery cost:** all stationery supplies cost used in dairy farm

k) **Miscellaneous cost:** cost items not included in the above cost items

l) **Total miscellaneous cost:** All cost items from 'c' to 'j' summed up and taken as miscellaneous cost.

m) **Interest on operating capital:** It was calculated on the prevailing bank interest rate for one year at 4% per annum.

ii. Fixed cost: The following were computed as fixed assets cost

a) **Depreciation of Cow shed**, bull and calves house**:** these were calculated on the bases of sw`traight-line method. The current value was divided by their respective service life. Since almost all shed has been constructed from iron sheets and mud, the useful life was taken as ten years.

b) **Depreciation of cows:** It was calculated on the bases of straight-line method. The present value of the cows was divided by the productive life of the cows. The productive life of the cows was considered seven lactations.

c) **Depreciation of equipments:** the depreciation of equipments was also calculated followingstraight-linemethod. The value ofthe equipments was divided by the service life of equipments. The service life of equipments was considered 1 to 5 years depending on their nature.

d) **Interest on fixed capital:** The interest on fixed capital was calculated on the basis of the prevailing bank interest rate at 4 % per annum.

iii. Returns: It included the value whole milk, milk by products, cow dung and appreciation of cattle.

a) **Sale of whole milk:** It is the quantity of whole milk and milk by products sold as well as consumed at home. The value of the latter was estimated at the prevailing market rate.

b) **Sale of cow- dung:** It is the value of all cow-dung produced and used as fuel and manure in the farm during the year under study was calculated on the basis of the prevailing market rate.

c) **Sale of cattle:** It is the value of all animals sold during the year at the prevailing market rate.

d) **Appreciation of cattle:** It is the value difference of the young stock at the beginning of the year and at the end of the year. Appreciation was calculated for 1-3 years of cattle, such as Heifers, young bull and calves.

APPENDIX II.Annual Cost and Income of Dairy Farms

Appendix 2. Annual cost of Cross breed medium size farms (,000,Birr)

HH NO	Conc	Min	Straw	Grefe	Hay	Total Conc	Dry fod	Labor	Med and vet	Artf Insem	Ele	Tran	water	Maint	Misc	Total var	Int on work cap	Gra total varcost	Dep	Intonfixed capital
1	6.7	0.45	0	0.225	4	7.15	4	2.813	0.5	0.06	0.12	1.458	1.2	0	0	17.526	0.526	18.051	5.231	1.565
2	4.7	0.18	1	0.4	2.6	4.86	3.6	1.8	0.2	0.03	0.06	1.	0.54	0	0	12.485	0.375	12.860	2.327	0.694
3	4.7	0.08	0	1.27	2.2	4.755	2.2	2.325	0.14	0.02	0.06	0.18	0.36	0	0	11.308	0.339	11.647	2.325	0.694
4	3.5	0.08	0.5	1.02	0.74	3.555	1.24	1.762	0.045	0.04	0.06	0.7	0.12	0	0	8.542	0.256	8.798	2.635	0.785
5	7.2	0.375	0	0.75	7	7.575	7	1.8	0.24	0.12	0.24	0.4	0.125	0	0	18.245	0.547	18.792	2.635	0.785
6	10.91	0.36	0	0.96	2.5	11.268	2.5	1.575	0.592	0.04	0.06	1.2	0.72	0	0	18.915	0.567	19.482	2.635	0.785
7	12.24	0.04	0.5	0.15	3.338	12.278	3.838	1.8	0.74	0.05	0.18	1.09	0.18	0	0	20.306	0.609	20.915	2.635	0.785
8	4.34	0.08	3	0	4.4	4.415	7.4	1.89	0.1	0.03	0.05	1.08	0.3	0	0	15.265	0.458	15.723	2.635	0.785
9	6.48	0.08	0	0	3	6.555	3	0.99	0.078	0.03	0.06	0.84	0.15	0	0	11.698	0.351	12.049	2.635	0.785
10	7.44	0.38	1	1.2	2.58	7.824	3.58	1.17	0	0.03	0.06	0.72	1.08	0	0	15.659	0.470	16.129	3.442	1.011
11	7.2	0.04	0.72	0.36	3	7.240	3.72	1.2	0.2	0.15	0.24	1.48	0.78	0	0	15.370	0.461	15.831	5.419	1.623
12	11.97	0	0	0	2.688	11.970	2.688	1.77	0.209	0.03	0	0.88	0.08	0	0	17.622	0.529	18.151	2.650	0.785
13	2.5	0	0.5	0.5	1.8	2.5	2.3	1.44	0.420	0.08	0.12	1.14	0.06	0	0.4	8.960	0.269	9.229	5.021	1.473
14	9	0.14	1.2	1.80	3.2	9.144	4.4	4.77	0.4	0.01	0.48	1.2	1.44	0.6	0.25	24.594	0.738	25.332	6.569	1.936
15	10.08	0	0.9	1.8	1.1	10.08	2	3.18	1.012	0.01	0.12	1.07	0.9	0	0.15	20.324	0.610	20.934	4.629	1.379
16	11.81	0	1.15	1.38	1.8	11.81	2.95	4.515	0.398	0.03	0.12	1.42	0.72	0.9	0.07	24.304	0.729	25.033	4.796	1.386
17	0.35	0.08	1.5	1	1.5	0.425	3	3.78	0.6	0.14	0.12	1.2	0.72	0.9	0	11.885	0.357	12.242	3.812	0.879
18	3.9	0	1	1	2.5	3.9	3.5	4.14	0.171	0.02	0.12	0.72	0.78	0	0.15	14.501	0.435	14.935	3.825	1.143
19	9.54	0.01	2.1	2.16	0	9.636	2.1	2.202	0.178	0.01	0.06	0.48	0.36	0	0.13	17.311	0.519	17.830	2.409	0.681
20	2.72	0.13	0	0.96	4.224	2.847	4.224	3	0.045	0.03	0.07	1.6	0.54	0	0	13.313	0.399	13.712	5.931	1.485
21	9.84	0.288	0.3	0.576	2	10.128	2.3	2.64	0.35	0.02	0.14	0.25	0.18	0	0.02	16.612	0.498	17.110	7.266	2.111
22	2.38	0.108	0.3	0	1.1	2.484	1.4	1.575	0.36	0.1	0.06	0.9	0.73	0	0	7.609	0.228	7.837	4.410	1.279

Appendix 2 (Continued)

HH NO	Conc	Min	Straw	Grefo	Hay	Total Conc	Dry fod	Labor	Med and vet	A.I	Ele	Tran	Water	Mai	Misc	Total var	Int on work cap	Gra total varcost	Dep	Inton fixed capital
23	10.8	0.12	0.4	1	2	10.92	2.4	1.725	0.1	0.02	0.06	0.69	0.292	0	0	17.202	0.516	17.718	3.877	1.126
24	8.64	0	0	3	2	8.64	2	1.120	0.5	0.06	0.02	0.144	0.9	0	0	16.384	0.491	16.875	2.606	0.736
25	8.01	0	0	1	0	8.01	0	0.895	0.135	0	0.06	0	0.72	0.02	0	11.040	0.331	11.371	1.158	0.345
26	6.174	0.05	0	0.3	1.3	6.224	1.3	1.564	0	0.09	0.12	0.62	0.12	0	0.12	10.458	0.314	10.771	2.630	0.766
27	5.477	0.036	0.4	0.1	0.5	5.513	0.9	0.9	0.6	0.03	0.06	0.35	0.12	0	0.03	8.603	0.258	8.861	1.146	0.341
28	13.2	0.05	0	0.5	2	13.25	2	3	0.201	0.02	0.12	1.032	1.08	0	0	21.208	0.636	21.844	4.606	1.370
29	8.735	0.34	0	1.2	2.3	9.075	2.3	1.95	0.15	0	0.12	0.25	0.12	0	10.5	15.315	0.459	15.774	1.850	0.540
30	11.508	0	0.5	0	2	11.508	2.5	1.07	0	0.03	0.06	0.12	0.36	0	0	15.648	0.469	16.117	3.277	0.979
31	9.716	0.12	1.23	0	2	9.836	3.23	1.44	0.055	0.14	0.12	0.97	0.36	0	0	16.151	0.484	16.635	3.010	0.901
32	12.72	0.12	3.6	0	4	12.84	7.6	1.283	0.17	0.20	0.10	0.6	0.9	0	0	23.695	0.711	24.405	3.064	0.917
33	10.08	0.05	4.14	0	4	10.13	8.94	1.803	0	0.14	0.12	0.288	0.36	0	0	21.781	0.653	22.434	4.017	1.203
34	10.92	0.06	0.8	0.32	1	10.98	1.8	1.95	0.203	0.23	0.12	0.776	0.36	0	0	16.734	0.502	17.236	2.408	0.721
35	11.28	0	1.64	1.12	1.1	11.28	2.74	2.730	0.230	0.07	0	1.092	0.48	0.20	0.23	20.162	0.605	20.767	3.362	0.999
36	5.7	0	0.25	1	1.15	5.7	1.4	1.785	0	0.05	0	0.345	0.84	0	0.04	11.160	0.335	11.495	3.218	0.963
37	13.68	2.34	1.8	2	7.5	16.02	9.3	6.180	0.72	0.07	0.24	3.060	1.5	0	0.36	39.450	1.183	40.633	7.322	2.043
38	9.42	0.08	1.05	1.47	2	9.5	3.05	3.390	0	0.02	0.12	0.745	0.72	0	0.07	19.078	0.572	19.650	3.140	0.921
39	3.278	0.042	1	0.5	1	3.32	2	1.463	0	0.02	0.06	0.12	0.23	0	0	7.713	0.231	7.944	2.207	0.661
40	12.53	0.71	2	0.5	2	13.24	4	2.775	0.6	0.29	0.30	2.46	1.38	0.5	0.30	26.345	0.790	27.135	4.710	1.411
To	321.302	7.083	34.48	31.72	95.9	328.384	130.4	89.158	10.64	2.61	4.41	34.67	22.907	3.12	2.46	660.478	19.813	680.29	143.48	40.392
Av	8.033	0.177	0.862	0.793	2.39	8.21	3.26	2.229	0.273	65	0.11	0.867	0.573	78	0.06	16.512	0.495	17.007	3.587	1.010

HH= Household Head Conc = Concentrate Grefo = Green Fodder Vet = Veterinary Tran = Transport In t= Interest
NO= Number Min = Mineral Med = Medicine Ele = Electricity Misc = Miscellaneous Cap = Capital
Gra= Grand var = variable Dep = Depreciation Mai = Maintenance

Appendix 3. Annual cost of cross breed small size farms under studied (000,Birr)

HH NO	Conc	Min	Straw	Grefo	Hay	Total Conc	Dry fod	Labor	Med and Vet	A.I	Ele	Tran	Water	Mai	Misc	Total var	on work cap	Gra total varcost	Dep	onfixed capital
1	4.04	0.21	0.200	.180	0.978	4.252	1.178	1.800	0.048	0.010	0.048	0.23	0.120	0	0.065	7.931	238	8.169	1.566	0.349
2	3.06	0.11	0	0.500	1.200	3.168	1.200	1.350	0.012	0.100	0.060	0.77	0.120	0	0	7.278	218	7.496	2.552	0.613
3	2.01	0.05	0	1.000	4.300	2.058	4.300	1.556	0.002	0.075	0.055	0	0.120	0	0	9.166	275	9.441	2.102	0.448
4	1.2	0	0.3	0	0	1.200	0.3	1.031	0.100	0.005	0.048	0.38	0.037	0	0	3.101	93	3.194	0.726	0.166
5	1.56	0.01	0.5	0.350	0	1.572	0.5	0.413	0.020	0.005	0	0.024	0.456	0	0	3.340	100	3.440	0.634	0.130
6	0.96	0.048	0.4	0.525	0.080	1.008	0.480	0.675	0.066	0.030	0.024	0	0.120	0	0.014	2.942	88	3.030	0.782	0.168
7	1.872	0	0.120	.500	1.000	1.872	1.120	0.675	0.036	0.025	0.048	0.030	0.150	0	0	4.456	134	4.590	0.670	0.131
8	2.208	0	0	0.624	0	2.208	0	0.448	0.050	0	0	0.144	0.243	0	0	3.717	111	3.828	0.631	0.136
9	2.198	0	0	0.768	0	2.198	0	0.615	0	0	0.010	0.120	0.150	0	0	3.861	116	3.977	0.574	0.120
10	7.692	0.050	0	0.500	1.000	7.742	1.000	1.238	0.050	0.010	0.042	0.252	0.075	0	0	10.909	327	11.236	1.745	0.339
11	0.484	0.010	0	0.250	0	0.494	0	0.544	0.014	0	0	0.060	0.025	0	0	1.387	42	1.428	0.799	0.181
12	2.144	0.018	0	1.6	2.000	2.162	2	0.815	0	0	0	0	0.720	0	0	7.297	219	7.516	0.697	0.157
13	6.420	0	0.41	0	2.040	6.420	2.445	0.890	0.180	0.040	0.072	0.324	0.129	0	0	10.500	315	10.815	2.036	0.481
14	1.920	0.048	0	0	1.020	1.968	1.020	0.848	0	0.015	0.012	0.478	0.576	0	0	4.917	147	5.064	1.095	0.274
15	8.100	0	0.88	0	0	8.100	0.880	1.890	0.060	0.060	0.120	2.970	0.100	0.3	0	14.480	434	14.914	1.905	0.410
16	1.314	0	0.68	0	0.34	1.314	1.020	1.170	0	0.010	0.100	0.610	0.319	0	0.090	4.633	139	4.772	1.662	0.377
17	0.550	0.280	0.6	0.4	1.300	0.830	1.900	1.867	0.345	0.040	0.120	0.586	0.420	1.7	0.040	8.248	247	8.495	3.479	0.768
18	8.46	0.144	0	0	2.105	8.604	2.105	0.945	0.040	0.010	0.060	0.736	0.540	0	0	13.040	391	13.431	1.933	0.451
19	1.344	0.012	0	0	0.9	1.356	0.900	0.563	0	0.005	0.060	0.080	0.288	0	0	3.252	98	3.349	1.537	0.331
20	6.360	0	1.2	0	0.6	6.360	1.800	1.350	0	0.040	0.009	0.242	0.400	0	0	10.201	306	10.507	1.928	0.422
21	6.816	0.016	0.3	0	1	6.832	1.300	1.350	0	0.060	0.072	0.100	0.290	0	0	10.004	300	10.304	1.990	0.481
22	10.5	0.240	0	0	18	10.74	18.000	1.920	0.012	0.090	0.060	0.672	0.188	0	0	31.682	950	32.632	2.003	0.445
23	1.08	0.058	0	0	0.72	1.138	0.720	0.619	0.040	0.015	0.120	0.120	0.230	0	0	3.001	90	3.091	0.706	0.158
24	1.47	0	0	0.4	1.04	1.470	1.040	0.538	0	0.030	0.060	0.075	0.180	0	0	3.793	114	3.906	0.560	0.126

Appendix 3 (Continued)

HH NO	Conc	Min	Straw	Grefo	Hay	Total Conc	Dry fod	Labor	Med and Vet	A.I	Ele	Tran	Water	Mai	Misc	Total var	Inter on work cap	Gra total varcost	Dep	Int onfixc apital
25	3.6	0	0	0	0.600	3.600	0.600	1.125	0	0	0.1	0.08	0.2	0	0	5.696	0.171	5.867	1.296	0.285
26	2.172	0	0.14	0.600	0.500	2.172	0.640	0.900	0	0.01	0.06	0.30	0.120	0	0.025	4.822	0.145	4.967	0.606	0.136
27	3.120	0.048	0.10	1.400	0.700	3.168	0.800	0.900	0.043	0.07	0.12	0.11	0.150	0	0.135	6.891	0.207	7.098	1.952	0.395
28	2.964	0.016	0.13	0.500	0.420	2.980	0.553	0.506	0.036	0.01	0.18	0.05	0.800	0	0.028	5.641	0.169	5.810	0.713	0.160
29	1.099	0.003	0.50	0.150	0	1.102	0.500	0.802	0.002	0	0	0.08	0.060	0.05	0.010	2.751	0.083	2.834	0.590	0.125
30	7.740	0.600	0	4.420	1	8.340	1	1.316	0.200	0.05	0.06	0.18	0.360	0.20	3.705	19.831	0.595	20.426	3.143	0.720
31	1.243	0.010	0.32	0.480	0	1.253	0.320	0.675	0.100	0.01	0.06	0.65	0.090	0	0.010	3.643	0.109	3.752	0.696	0.151
32	6.984	0.038	0.20	0	3.500	7.022	3.700	1.688	0.200	0.02	0.06	0.74	0.060	0	0	13.489	0.405	13.894	1.393	0.335
33	2.218	0.036	0	0	2.700	2.254	2.700	1.575	0.010	0	0.06	0.72	0.040	0	0	7.359	0.221	7.579	0.887	0.212
34	6	0.072	0	0	1.620	6.072	1.620	1.650	0.050	0.01	0.06	0.54	0.080	0	0	10.082	0.302	10.384	2.112	0.520
35	3.480	0.090	0	0.400	1.200	3.570	1.200	1.294	0.048	0.05	0.06	0.12	0.015	0	0	6.752	0.203	6.954	1.698	0.392
36	4.644	0	0	0.288	0.710	4.644	0.710	1.613	0	0.01	0.06	0.19	0.144	0	0	7.656	0.230	7.885	1.363	0.331
37	2.712	0.036	0	0.720	3.360	2.748	3.360	2.025	0	0.02	0.12	0.60	0.240	0	0	9.833	0.295	10.128	2.047	0.454
38	7.560	0.104	0	0.148	2.600	7.664	2.600	2.984	0	0.02	0.11	0.64	0.588	0	0	14.756	0.443	15.199	2.250	0.487
39	3.672	0.037	0	0.300	0.800	3.709	0.800	2.025	0	0.02	0.06	0	0.150	0	0	7.059	0.212	7.271	1.305	0.287
40	4.620	0	0	1	1.200	4.620	1.200	1.031	0.200	0.07	0.07	0.10	0.050	0	0	8.346	0.250	8.597	2.514	0.585
41	5.400	0.075	0.70	1	3.000	5.475	3.700	0.938	0.550	0.09	0.18	0.40	0.210	0	0	12.543	0.376	12.919	3.143	0.750
42	3.720	0	0.70	0.960	1.028	3.720	1.728	0.350	0.020	0.13	0.06	0.07	0.300	0	0.040	7.373	0.221	7.594	0.745	0.169
43	5.040	0.144	0	0	1.200	5.184	1.200	0.600	0.600	0.05	0.06	0	0.250	0	0.036	7.980	0.239	8.219	1.663	0.393
44	2.100	0.010	0.30	0.440	1.	2.110	1.300	0.840	0.115	0	0.06	0.05	0.180	0	0.020	5.115	0.153	5.268	1.281	0.277
45	4.088	0	0.26	0.650	1.	4.088	1.260	0.450	0.110	0.09	0.06	0.25	0.120	0	0	7.078	0.212	7.290	0.634	0.151
Total	167.938	2.622	8.94	21.05	67.76	170.6	76.699	50.393	3.359	137	2.86	14.9	10.203	0.25	4.218	357.83	10.734	368.563	66.348	14.977
Av	3.732	0.058	0.2	0.468	1.506	3,790	1.704	1.120	0.075	31	64	0.33	0.227	0.01	0.094	7.952	0.239	8,190	1,474	0.333

Appendix 4. Annual cost of local breed medium size farms under studied (000,Birr)

HH NO	Conc	Min	Straw	Grefo	Hay	Total Conc	Dry fod	Labor	Med and vet	A.I	Ele	Tran	Water	Misc	Total var	Inter on work cap	Gra total varcost	Dep	Inton fixed capital
1	3.150	0.120	3.270	0.500	0.500	1	1.500	1.800	0	0	0.060	0.08	0.120	0.62	7.954	0.239	8.193	0.653	0.152
2	0.960	0	0.960	0.600	1.660	0.500	1.100	0.325	0.060	0.01	0.060	0.12	0.320	0.05	4.739	0.142	4.881	0.636	0.151
3	0.960	0	0.960	0.800	0.500	1	1.800	1.343	0.015	0	0.060	0.50	0.245	0.03	5.457	0.164	5.620	1.481	0.346
4	1.073	0	1.073	1	0.284	1.200	2.200	1.125	0	0.02	0.060	0.05	0.230	0	5.037	0.151	5.188	1.065	0.241
5	0.280	0	0.280	1	1	0.500	1.500	1.193	0.512	0	1.800	0.14	0.180	0	6.605	0.198	6.803	0.649	0.154
6	3.990	0.018	4.008	0.200	3.600	0.375	0.575	1.463	0	0.04	0.065	0	0.120	0.05	9.910	0.297	10.207	1.111	0.261
7	0.432	0	0.432	0.800	0.300	0.800	1.600	1.125	0	0	0.060	0	0.090	0	3.607	0.108	3.715	0.325	0.067
8	1.120	0.200	1.320	0.900	0.300	0.500	1.400	1.415	0.040	0	0.015	0.27	0.190	0.07	5.018	0.151	5.169	1.035	0.256
9	0.960	0	0.960	1	5.400	1	2.000	1.688	0.100	0	0.060	0	0.182	0	10.390	0.312	10.701	0.864	0.198
10	11.013	0.012	11.025	1.222	0.700	1.150	2.372	1.650	0.010	0.09	0.060	0.06	0.120	0.18	16.267	0.488	16.755	1.810	0.406
11	2.212	0	2.212	0.420	0.550	1.200	1.620	1.350	0.040	0	0.060	0.05	0.125	0.01	6.017	0.180	6.197	0.739	0.159
12	0.912	0	0.912	0.500	0.500	1.500	2	1.575	0.006	0	0.060	0.06	0.075	0	5.188	0.156	5.344	0.719	0.153
13	1.965	0	1.965	0.400	0.300	0.500	0.900	1.688	0.040	0	0.075	0.05	0.150	0	5.167	0.155	5.322	0.961	0.211
14	2.800	0	2.800	0	1.200	1.680	1.680	0.975	0	0	0.060	0.62	0.240	0.03	7.603	0.228	7.831	1.820	0.479
15	1.920	0	1.920	0.480	0.720	0.500	0.980	1.050	0	0	0.030	0.30	0.180	0.02	5.198	0.156	5.354	0.990	0.218
16	1.920	0	1.920	0.500	0.700	1.200	1.700	1.800	0	0	0	0.20	0	0.02	6.344	0.190	6.534	1.100	0.266
17	0.160	0.018	0.178	1.008	1.500	1.000	2.008	1.388	0	0	0	0.06	0	0.04	5.165	0.155	5.319	0.834	0.214
18	1.860	0.015	1.875	0.500	0.500	0.600	1.100	1.350	0.020	0.02	0.060	0.15	0.120	0	5.190	0.156	5.346	1.030	0.228
19	0.918	0	0.918	0.300	0.300	0.720	1.020	1.125	0.020	0.01	0.060	0.08	0.120	0	3.648	0.109	3.757	1.031	0.229
20	0.480	0	0.480	1.600	0.570	0.800	2.400	2.006	0	0	0.090	0.14	0	0.03	5.714	0.171	5.885	1.392	0.332
21	0.960	0	0.960	0.480	0.320	1.100	1.580	1.125	0	0	0	0.21	0.180	0.02	4.393	0.132	4.525	1.268	0.303
22	0	0	0	1.026	0.540	0.500	1.526	2.010	0	0	0	0.14	0.160	0.03	4.403	0.132	4.535	1.219	0.293

Appendix 4 (Continued)

HH NO	Conc	Min	Straw	Grefo	Hay	Conc	Dry fo	Labor	Med and vet	A. I	Elec	Tran	Wat er	Misc	Total var	Inter on work cap	Gra total varcost	Dep	Intonfix ed capital
23	0.960	0	0.960	1.350	1.480	0.270	1.620	1.575	0.030	0	0	0.150	0.09	0.048	5.953	0.179	6.132	1.290	0.319
24	0.960	0	0.960	0.480	1	0.180	0.660	1.125	0	0	0	0.180	0	0.037	3.962	0.119	4.081	0.982	0.242
25	0	0	0	0.600	0.630	0.500	1.100	1.481	0	0	0	0.165	0	0.018	3.394	0.102	3.496	0.887	0.219
26	0.960	0	0.960	0.800	0.760	0.300	1.100	1.763	0.020	0	0	0.120	0	0.010	4.733	0.142	4.874	0.962	0.228
27	0.280	0	0.280	1	1	0.500	1.500	1.193	0.512	0	1.8	0.140	0.18	0	6.605	0.198	6.803	0.649	0.154
28	0.912	0	0.912	0.500	0.500	1.500	2	1.575	0.006	0	60	0.060	0.08	0	5.188	0.156	5.344	0.719	0.153
29	0.160	0.02	0.178	1.008	1.500	1	2.008	1.388	0	0	0	0.056	0	0.035	5.165	0.155	5.319	0.834	0.214
30	0.960	0	0.960	0.480	1	0.180	0.660	1.125	0	0	0	0.180	0	0.037	3.962	0.119	4.081	0.982	0.242
Tot	45.237		45.638	21.454	29.814	23.755	45.209	41.790	1.431	0.2	4.655	4.326	3.49	1.375	177.90	5.337	183.238	30.040	68.724
Av	1.508	13	1.521	0.715	0.994	0.792	1.507	1.3930	0.048	6	155	0.144	116	0.046	5.932	0.178	6.110	1.001	0.236

HH= Household Head Conc= Concentrate Grefo= Green Fodder Vet= Vetrenary Tran= Transport Int= Interest
NO= number Min= Mineral Med= Medicine Ele= Electricity Misc= Miscellaneous Cap= Capital
Gra= Grand var= variable Dep= Depreciation

Appendix 5. Annual cost of local breed small size farms under studied (Birr)

HH NO	Conc	Min	Straw	Grefo	hay	Conc	Dry fod	Labor	Med and Vet	A.I	Ele	Tran	Water	Misc	Total var	Inter on work cap	Gra total var	Dep	Int onfixed capital
1	696	36	732	0	130	500	500	475	0	0	0	0	48	72	0	120	1957	59	2016
2	754	48	802	0	100	0	0	383	40	20	60	0	155	0	0	155	1500	45	1544
3	1260	10	1270	0	0	720	720	455	9	25	34	0	180	384	0	564	3043	91	3134
4	960	0	960	0	100	300	300	368	0	0	0	0	144	162	0	306	2034	61	2094
5	6586	0	6586	940	1000	1000	1940	750	40	0	40	120	180	203	0	503	10819	325	11143
6	1362	0	1362	0	800	1000	1000	828	0	0	0	84	720	405	0	1209	5199	156	5354
7	1812	0	1812	0	0	840	840	905	0	5	5	120	60	230	0	410	3972	119	4091
8	1137	0	1137	0	200	1000	1000	1366	50	0	50	96	0	230	0	326	4079	122	4201
9	1392	0	1392	0	200	500	500	370	0	0	0	0	65	135	0	200	2662	80	2742
10	1134	75	1209	0	0	280	280	571	60	10	70	12	132	91	0	235	2365	71	2435
11	780	45	825	100	900	1000	1100	503	40	0	40	0	60	180	0	240	3608	108	3716
12	552	0	552	0	360	480	480	419	0	0	0	60	60	24	10	154	1965	59	2024
13	675	0	675	0	400	1000	1000	138	4	0	4	0	60	30	10	100	2317	69	2386
14	1326	75	1401	175	360	1600	1775	488	35	10	45	60	60	175	80	375	4444	133	4577
15	584	0	584	360	500	580	940	431	60	0	60	60	30	50	60	200	2716	81	2797
16	1920	0	1920	0	800	1000	1000	406	200	0	200	60	96	45	45	246	4572	137	4709
17	2160	0	2160	600	600	0	600	188	15	0	15	0	30	30	30	90	3653	110	3762
18	574	18	592	96	80	500	596	1013	0	0	0	24	36	72	0	132	2413	72	2485
19	233	18	251	0	0	1440	1440	1013	0	0	0	24	192	144	0	360	3063	92	3155
20	1350	0	1350	0	1260	1260	1260	651	0	0	0	0	0	252	0	252	4773	143	4916
21	2400	180	2580	300	0	60	360	1125	0	10	10	24	0	120	0	144	4219	127	4346
22	2160	0	2160	0	0	1800	1800	650	0	0	0	24	76	108	0	208	4818	145	4963
23	1920	0	1920	0	0	1800	1800	675	0	5	5	36	240	162	0	438	4838	145	4983
24	1194	18	1212	270	120	300	570	1125	0	0	0	30	24	240	0	294	3321	100	3421
25	1836	15	1851	0	50	500	500	1350	0	20	20	60	300	240	0	600	4371	131	4502

Appendix 5 (Continued)

HH NO	Conc	Min	Straw	Grefe	Hay	Conc	Dry fod	Labor	Med and Vet	A.I	Ele	T r a n	Water	Misc	Total var	Inter on work cap	Gra Total varcost	Dep	IntonFixed capital
26	0	0	0	300	0	2500	2800	450	0	5	5	60	0	108	0	168	3423	103	3526
27	900	0	900	0	945	0	0	675	0	0	0	60	0	18	0	78	2598	78	2676
28	480	0	480	0	0	100	100	326	0	0	0	60	20	216	0	296	1202	36	1238
29	0	0	0	0	800	1000	1000	563	0	0	0	60	0	48	0	108	2471	74	2545
30	420	0	420	0	0	480	480	894	30	5	35	60	60	25	0	145	1974	59	2033
31	420	0	420	400	0	0	400	1350	0	0	0	24	0	240	0	264	2434	73	2507
32	130	0	130	200	24	150	350	563	0	0	0	12	0	75	0	87	1154	35	1188
33	1800	60	1860	600	240	0	600	788	18	5	23	96	0	125	0	221	3732	112	3843
34	960	0	960	800	1000	1400	2200	1575	15	0	15	120	480	365	0	965	6715	201	6916
35	830	48	878	450	1500	800	1250	375	60	10	70	120	0	72	0	192	4265	128	4393
36	2400	192	2592	800	765	960	1760	375	0	30	30	120	0	73	0	193	5715	171	5886
37	1104	39	1143	270	1000	1340	1610	338	35	0	35	24	0	140	0	164	4290	129	4418
38	1260	0	1260	96	66	720	816	725	35	0	35	60	0	95	0	155	3057	92	3148
39	4345	0	4345	490	2880	500	990	540	0	0	0	60	188	150	0	398	9153	275	9428
40	924	9	933	300	200	300	600	1125	100	0	100	60	100	240	30	430	3388	102	3490
41	780	0	780	300	86	0	300	1186	0	0	0	60	24	120	10	214	2565	77	2642
42	285	18	303	500	0	500	1000	460	0	0	0	120	0	145	15	280	2043	61	2104
43	2160	0	2160	0	0	1000	1000	515	25	5	30	60	50	130	45	285	3990	120	4110
44	746	0	746	400	72	0	400	666	0	0	0	60	0	60	10	130	2014	60	2074
45	480	0	480	300	150	300	600	1013	180	0	180	0	30	0	40	70	2493	75	2567
46	480	0	480	320	560	240	560	1350	30	0	30	0	0	0	0	0	2980	89	3069
47	120	0	120	600	300	120	720	900	0	0	0	60	80	120	18	278	2318	70	2388
48	960	0	960	450	360	500	950	1013	0	0	0	36	0	80	32	148	3431	103	3533

Appendix 5 (Continued)

HH NO	Conc	Min	Straw	Grefo	Hay	Total Conc	Dry fo	Labor	Med and Vet	A.I	Ele	Tran	Water	Misc	Total var	Int on work cap	Gra total varcost	Dep	Intonfixed capital
49	960	0	960	450	360	300	750	1013	0	0	0	60	0	144	24	228	3311	99	3410
50	1410	0	1410	200	400	150	350	1575	20	15	35	60	100	120	0	280	4050	121	4171
51	1080	0	1080	0	450	0	0	563	0	0	0	24	60	65	0	149	2242	67	2309
52	600	0	600	130	500	940	1070	788	100	0	100	0	60	0	25	85	3143	94	3237
53	1296	0	1296	0	600	0	0	563	60	0	60	0	90	0	26	116	2635	79	2714
Total	64086	904	64990	11197	21218	33760	44957	38903	1261	180	1441	2430	4290	6758	510	13988	185496	5565	191061
Av	1209	17	1226	211	400	637	848	734	24	3	27	46	81	128	10	264	3500	105	3605

HH = Household Head Conc = Concentrate Grefo= Green Fodder Vet = Veterinary Tran= Transport Int = Interest
NO = Number Min = Mineral Med = Medicine Ele = Electricity Misc= Miscellaneous Cap = Capital
Gra = Grand var = variable Dep = Depreciation

Appendix 6. Annual income of cross breed medium size farms (Birr)

HH NO	InWm So	InYo So	InHei So	InCo So	InBu So	VaAp Ca	VaAp Hei	VaAp YoBu	VaCo Du	Gra Tot
1	39840	0	0	0	0	2500	12000	0	0	54340
2	31260	0	0	0	2000	2000	3000	0	0	38260
3	20520	0	0	0	0	2000	8000	0	300	30820
4	12960	0	0	0	0	1000	8000	0	200	22160
5	47760	0	0	0	0	3800	9000	0	0	60560
6	29070	0	0	0	0	2800	4000	0	0	35870
7	29340	3600	0	0	0	1500	12000	0	0	46440
8	45540	0	0	0	0	2200	4000	2000	0	53740
9	46080	0	0	0	0	2400	12000	0	400	60880
10	17190	0	0	0	0	2000	6000	0	240	25430
11	16395	0	0	0	0	2000	6000	0	0	24395
12	25500	4200	0	0	0	500	11000	0	0	41200
13	43876	0	0	0	0	2500	3000	0	0	49376
14	46440	0	0	0	0	8500	10500	0	0	65440
15	29520	0	0	0	0	1000	6000	0	0	36520
16	26730	0	0	0	0	800	20000	0	0	47530
17	26010	0	0	0	0	2300	12000	0	0	40310
18	19260	0	0	21000	0	1650	4000	0	0	45910
19	28080	0	0	0	0	2200	0	0	1200	31480
20	55800	0	0	5000	0	4000	0	0	0	64800
21	15120	0	0	4500	0	500	0	0	400	20520
22	19980	0	0	0	0	400	3000	0	0	23380
23	28620	0	0	0	0	3200	3000	0	0	34820
24	20790	0	0	0	0	800	0	500	3390	25480
25	12512.	0	0	2200	0	200	3800	0	621	19333.
26	11900	0	0	0	0	500	8000	0	0	20400
27	7507	0	0	6400	0	100	2500	0	0	16507
28	52305	0	0	0	0	1600	12000	0	0	65905
29	20959	0	0	10000	0	0	4000	3700	480	39139.
30	34120	0	0	0	0	1300	2000	0	540	37960
31	36480	0	0	0	0	1900	11800	0	0	50180
32	22860	0	0	0	0	675	10000	0	0	33535
33	30030	0	0	0	0	3000	25000	0	0	58030
34	20340	0	0	0	0	700	3500	0	640	25180
35	47970	0	0	0	0	1400	5000	0	0	54370
36	21780	0	0	0	0	300	0	0	300	22380
37	14400	127440	13000	0	0	900	18000	0	0	173740
38	21150	6480	0	0	0	1200	3000	0	250	32080
39	15592.5	0	0	0	0	500	2000	0	384	18476.5
40	49950	0	0	0	0	4000	8000	0	0	61950
To	1141537	141720	13000	49100	2000	70825	275100	6200	8945	1708827
Av	28538.	3543	325	1227.5	52.	1770.6	6877.5	155	223	42720

Appendix 7. Annual income of cross breed small size farms under studied/Birr

HH	InWmSo	VaMan	InCaSo	InCoSo	InBuSo	VaApCa	VaApHei	VaApYobu	VaCoDu	GraTotal
1	15840	0	0	0	0	150	0	0	0	15990
2	9000	0	0	2800	0	2500	4000	0	1200	19500
3	15000	0	0	0	0	500	3500	0	400	19400
4	2970	0	50	0		500	0	0	120	3640
5	5400	0	0	0	0	800	0	0	120	6320
6	6390	0	0	0	1500	2000	0	0	384	10274
7	7650	0	0	0	0	700	8000	0	384	16734
8	8040	0	0	0	0	0	2500	0	600	11140
9	6270	0	0	0	0	700	0	0	480	7450
10	11385	0	0	0	0	500	3000	0	270	15155
11	4868	0	0	0	0	100	0	0	405	5373
12	10065	0	0	4000	0	300	9000	0	1080	24445
13	17460	0	0	.	0	2000	0	0	284	19744
14	7838	0	0	0	0	200	2500	0	720	11258
15	27000	0	0	0	0	200	8000	0	0	35200
16	16710	0	0	0	0	0	7000	0	0	23710
17	20349	0	0	0	0	600	3000	0	0	23949
18	14520	0	0	0	0	200	6000	0	0	20720
19	11820	0	0	0	0	800	5000	0	150	17770
20	10808	0	0	0	0	300	2000	500	588	14196
21	12127	0	0	0	0	200	6000	0	720	19047
22	21960	0	0	0	0	2000	6000	0	0	29960
23	11963	0	0	0	0	600	0	0	720	13283
24	8250	0	0	0	0	1200	0	0	144	9594
25	12870	0	0	0	0	0	8000	500	390	21760
26	8168	0	0	0	0	0	2000	0	384	10552
27	15300	0	0	0	0	600	3000	0	110	19010
28	5940	0	0	0	0	500	3500	0	384	10324
29	5610	0	0	0	0	200	2000	.	384	8194
30	18000	0	0	0	0	500	4000	0	0	22500
31	5280	0	0	0	0	100	0	0	0	5380
32	21120	0	0	0	0	3400	12000	0	0	36520
33	9000	0	0	0	0	1600	2000	0	480	13080
34	16200	0	0	0	0	20000	4500	.	480	41180
35	27120	0	0	0	0	400	0	0	0	27520
36	7020	0	0	0	0	500	4000	700	480	12700
37	26100	0	0	0	0	700	2000	0	480	29280
38	29400	0	0	0	0	950	0	0	540	30890
39	14880	0	0	0	0	1000	1000	0	240	17120
40	6300	0	0	0	0	700	10000	0	960	17960
41	29494	0	0	0	0	700	5000	0	600	35794
42	4860	0	0	0	0	1150	3000	0	600	9610

Appendix 7 (Continued)

HH NO	InWm So	Va Manu	InCa So	InCo So	InBu So	VaAp Ca	Va Ap Hei	VaAp YoBu	VaCo Du	GraTot
43	11178	480	0	0	0	0	3500	0	0	15158
44	6930	0	0	0	0	150		0	160	7240
45	9540	0	0	3000	0	50	0	0	384	12974
Total	573991	480	50	9800	1500	50250	145000	1700	15825	798596
Av	12755	11	1	223	33	1117	3222	40	352	17747

Appendix 8. Annual income for local breed medium size farms (Birr)

HH NO	In WmSo	Va Manu	In CoSo	In Buso	Va ApCa	Va Ap Hei	Va Ap Yobu	VaCoDu	Gra total
1	4760	0	0	0	280	3000	750	480	9270
2	4770	0	1200	0	0	1800	0	600	8370
3	5220	0	0	0	100	700	700	600	7320
4	5940	0	0	0	1200	3000	0	720	10860
5	11700	0	0	0	930	2500	800	0	15930
6	6300	0	0	0	600	3000	0	300	10200
7	4140	0	0	0	300	0	0	400	4840
8	4320	0	0	0	360	2250	350	480	7760
9	9630	0	0	2500	1200	2000	0	350	15680
10	9090	0	2500	0	250	1000	0	0	12840
11	4875	0	0	.	350	0	900	300	6425
12	5813	0	0	0	500	0	0	384	6697
13	7575	0	0	0	250	0	0	384	8209
14	8880	240	0	0	350	900	0	0	10370
15	8100	210	0	0	220	1800	1000	0	11330
16	5250	150	0	0	700	500	2000	0	8600
17	7695	180	0	0	1000	700	2200	0	11775
18	8010	0	0	0	1100	800	0	480	10390
19	4995	0	0	0	1600	2000	3000	480	12075
20	6405	0	0	0	450	2000	500	720	10075
21	3465	0	0	0	450	480	0	460	4855
22	4794	0	0	0	280	500	0	640	6214
23	4238	0	0	0	450	800	0	420	5908
24	3788	0	0	0	650	2000	1200	220	7858
25	3510	0	0	0	360	500	0	190	4560
26	4680	0	0	0	600	1300	0	200	6780
27	11700	0	0	0	930	2500	800	0	15930
28	5813	0	0	0	500	0	0	384	6697
29	7695	180	0	0	1000	700	2200	0	11775
30	3788	0	0	0	650	2000	1200	220	7858
Total	186937	960	3700	2500	17610	38730	17600	9412	277449
Av	6231	32	123	86	587	1291	587	314	9248

Appendix 9. Income of local breed small size farms (Birr)

HHNO	InWmSo	InCoSo	InBuSo	VaApCa	VaApHei	VaApYobu	VaCoDu	GraTot
1	3099	0	0	500	0	0	540	4139
2	2430	0	0	200	0	0	270	3900
3	3375	0	0	600	0	0	189	4164
4	2700	0	0	700	0	0	720	4120
5	5310	0	0	500	0	0	540	6350
6	2970	0	0	300	800	0	250	4320
7	2025	0	0	250	500	0	160	2935
8	2475	0	0	650	1500	0	150	4775
9	990	0	0	150	0	0	150	1290
10	1350	0	0	300	0	0	120	1770
11	1710	700	0	200	1300	0	180	4090
12	2430	0	0	150	0	0	240	2820
13	990	0	0	100	0	0	0	1090
14	3240	0	0	100	0	0	0	3340
15	900	0	0	100	1200	0	240	2440
16	1425	0	0	200	700	0	480	2805
17	1530	0	0	150	0	0	0	1680
18	2430	0	0	1300	0	2000	100	5830
19	2610	0	0	300	800	0	100	3810
20	1575	0	0	300	0	0	144	2394
21	3300	0	0	300	0	0	150	3750
22	1950	0	0	150	0	0	144	2244
23	2175	0	0	100	0	0	144	2419
24	4140	0	0	300	1500	0	480	6420
25	3780	0	0	600	1000	.	480	5860
26	1898	1000	0	0	600	0	144	3642
27	1500	0	0	80	0	0	125	1705
28	4200	0	0	240	480	0	144	5064
29	1800	0	1200	200	0	0	160	3360
30	2160	0	0	250	0	0	0	2410
31	2700	0	0	250	2000	0	360	5310
32	990	0	0	100	0	500	100	1690
33	1800	0	0	0	0	500	960	2760
34	2520	0	0	200	0	250	240	3210
35	2160	0	0	200	0	0	300	2660
36	4140	0	0	200	1000	0	300	5640
37	2340	0	0	230	800	500	900	4770

Appendix 9 (Continued)

HH NO	InWm So	InCo So	InBu So	VaAp Ca	VaAp Hei	VaAp Yobu	VaCo Du	Gra tot
38	1425	0	0	100	0	0	384	1909
39	3510	0	0	50	0	0	384	3344
40	5805	0	0	100	300	700	384	7289
41	2520	0	0	50	370	0	384	3324
42	2550	0	0	700	1800	0	350	5400
43	1350	0	0	0	1000	0	384	2734
44	1313	0	0	50	850	0	180	2393
45	1613	0	0	300	700	0	180	2793
46	180	0	0	200	300	0	0	2300
47	2925	0	0	150	400	0	260	3735
48	990	0	0	200	400	0	350	2340
49	765	0	0	0	500	350	78	1693
50	4320	0	0	500	800	0	120	5740
51	938	0	0	50	0	0	0	988
52	1425	0	0	350	970	0	0	2745
53	1080	0	0	400	0	0	0	1480
Total	121824	1700	1200	13650	22570	4800	13142	181181
Av	2299	32	23	258	426	92	248	3419

HH = Household Head
NO = Number
InWmSo = Income from Whole milk Sold
InCoSo = Income from Cow Sold
InBuSo = Income from Bull Sold
VaApCa = Value of Appreciation of Calves
VaApHei = Value of Appreciation of Heifers
VaApBu = Value of Appreciation of Bull
VaCoDu = Value of Cow Dung

APPENDIX III. .Partial Correlation Matrix

Appendix 10. Correlation matrix for cross breed cows owning medium size farms

	Milk (liters) /cow	Dry fodder (qt) /cow	Concentrate (qt) /cow	Miscellaneous cost(Birr)/ cow	Green fodder (qt) /cow	Labor (person days)/cow	Stage of lactation /cow
Milk (liters)/cow	1						
Dry fodder (qt)/cow	0.2656	1					
Concentrate (qt)/cow	-0.06	0.0138	1				
Miscellaneou s cost/cow	0.0027	0.1104	-0.192	1			
Green fodder(qt) /cow	-0.198	-0.267	-0.102	-0.0445	1		
Labor (person days)/cow	-0.108	0.1408	-0.243	0.32901	0.3218	1	
Stage of lactation/cow	-0.001	0.210	0.0137	0.12324	0.0914	0.02083	1

Appendix 11. Correlation matrix for small size cross breed farms

	Milk (liters) /cow	Green fodder (qt) /cow	Concentrate (qt) /cow	Dry fodder (qt) /cow	Labor (person day) /cow	Miscellaneous cost(Birr) /cow	Stage of lactation /cow
Milk (liters)/ cow	1						
Green fodder (qt)/cow	-0.0639	1					
Concentrate (qt)/cow	0.2462	0.04374	1				
Dry fodder (qt)/cow	0.23408	-0.1433	0.28669	1			
Labor (person days)/cow	0.28503	-0.1715	0.16578	0.10817	1		
Miscellaneous cost (Birr)/cow	0.30319	0.08894	0.30129	0.16675	0.15146	1	
Stage of lactation/cow	0.04301	-0.0897	0.18883	0.04675	-0.073	-0.006	1

Appendix 12.Correlation matrix for local breed cows owning medium size farms

	Milk (liters) /cow	Green fodder (qt) /cow	Concentrate(qt) /cow	Dry fodder (qt) /cow	Labor (person day) /cow	Miscellaneous cost (Birr) /cow	Stage of lactation /cow
Milk (liters)/ cow	1						
Green fodder (qt)/cow	0.33982	1					
Concentrate (qt)/cow	0.1375	0.02152	1				
Dry fodder (qt)/cow	0.23928	-0.1293	-0.0232	1			
Labor (person days)/cow	-0.106	-0.1595	0.19595	0.2286	1		
Miscellaneous cost (Birr) /cow	0.28588	-0.0867	0.20181	-0.099	-0.489	1	
Stage of lactation/cow	0.1858	0.13684	-0.3159	-0.001	-0.318	0.27433	1

Appendix 13. Correlation matrix for local breed owning small size farms

	Milk (liters) /cow	Dry fodder (qt) /cow	Miscellaneous cost(Birr) /cow	Stage of lactation /cow	Labor (person day) /cow	Green fodder (qt) /cow	Concentrate(qt)/ cow
Milk (liters) /cow	1						
Dry fodder (qt)/cow	0.18965	1					
Miscellaneous cost (Birr)/cow	0.33434	0.3279	1				
Stage of lactation /cow	0.07508	0.0586	0.18761	1			
Labor (person day) /cow	0.13931	0.0568	0.06913	-0.1696	1		
Green fodder (qt)/cow	-0.1218	0.053	-0.0622	0.00797	-0.226	1	
Concentrate (qt)/cow	0.15932	0.0600	0.33632	0.09466	-0.049	0.2463	1

Appendix 14. Interview Schedule for households to collect data on Dairy production and Marketing

Mekelle University

College of Business and Economics

Department of Cooperative studies

This interview schedule is prepared to collect data from households for the purpose of studying the dairy production and Marketing aspects in Mekelle town, Tigray Region, Ethiopia.

1.

No	Name of respondent	Sex	Age	Religion	Education	Family Size
1						

1.1. How many cattle population do you raise? _____

_____Milking Cows _____Heifers

_____ Dry Cows _____Bulls

_____Calves

2. Is the dairy farm your major occupation? Yes/No

2.1. If the answer for q.2 is no, what is your major occupation?

a) Civil servant

b) Trader

c) Informal sector

d) Others, specify, _____

3. What motivates you for investing in dairy farming?

a) Profitability

b) Supplement consumption for family

c) Part time job

d) Others, specify,_____

4. Please circle the source of your dairy cows (type):

a) Purchased

b) Inherited from family

c) Both

4.1 Place of origin of cows

a) Mekelle

b) Outside Mekelle with in region

c) Outside the region

d) Combination of above specify_____

e) Others Specify_____

5. Select Duration of lactation period.

a) 1-3 years

b) 4-7 years

c) 8-11 years

d) 12-15 years

6. Breed type:

a) Indigenous (not improved)

b) Indigenous (improved)

c) Exotic blood (mixed)

d) Exotic blood (pure)

e) Combination of above specify_____

f) Others Specify_____

6.1. Breed type preference (in terms of productivity, reduced cost, quality product, Profitability, management etc)

a) Indigenous (not improved)

b) Indigenous (improved)

c) Exotic blood (mixed)

d) Exotic blood (pure)

e) Combination of above specify_____

f) Others Specify_____

6.2. Reason for preference (emphasize boldly):

_____

_____

7. What methods do you use for animal reproduction?

a) Artificial insemination

b) Bull (local)

c) Bull (improved)

d) Combination, specify_____

e) Others, specify_____

8. Milk production capacity of cows per day.

a) Indigenous (not improved) _____(litre)

b) Indigenous (improved) _____(litre)

c) Exotic blood (mixed) _____(litre)

d) Exotic blood (pure) _____(litre)

8.1. Which breed type is profitable?

a) Indigenous b) Exotic c) both a and b

9. What is the price of breeds per cow?

a) Indigenous (not improved) _____ Birr

b) Indigenous (improved) _____ Birr

c) Exotic blood (mixed) _____ Birr

d) Exotic blood (pure) _____ Birr

10. A/ How much was your initial capital in cash?

a) <5000 birr b) 5000-7000 birr c) 8000-10,000 birr d) 11,000-13,000 birr

e) >13,000 birr

B/ what was the source of capital to start?

a) Own fund b) bank loan c) gift from relatives d) micro finance loan

e) Others, specify

i) If it is from bank loans, how much? _____

C) What was the price per cow? _____

D) What cost have you incurred to make the shed? _____

E) How much cost do you incur per year?

Administrative cost_____Birr transport cost_____Birr

Animal feed cost _____Birr miscellaneous cost_____Birr

F) How much income (Revenue) do you earn per year? _____Birr

11. A) Feed types of livestock? Specify for each type of animal (breed)

_____

_____

B) Source of feed:

a) Own b) purchased c) combination, state_____ d) Others, specify_____

i) If purchased feed, months of purchased _____

ii) Type of feed for each month:

_____

_____

iii) At what rate, (price for each type of feed) _____

C) How do you feel on the current price of animal feed in the market in relation to the past prices?)

i) Expensive

ii) Medium

iii) Cheap

iv) No change

v) Others, specify _____

12. Select from the alternatives of drinking water source for the animals.

a) Tap water

b) Water well

c) River/ Stream

d) Others, specify _____

13. A/ who is responsible to take care of the dairy cows? _____

B) Do you employee your self in the dairy farm? A) Yes B) No

C) .Are there any family employed in your dairy farm? A) Yes B) No

D) If the answer for C is yes, please list the family members involved in dairy husbandry (participants).

_____

_____

14. A) Are there hired laborers in the farm? A) Yes B) No

B) If the answer for A is yes, what is the average number of hired workers per week/month? In the farms? If any please mark (✓) in the box given.

a) 1-2 b) 5-7 c) 8-10 d) 11-15 e) others, specify_____

C/ How much is their salary / wage category in average? Mark (✓) in one.

a) 50-100 b) 100-200 c) 200-250 d) >250

15. A/Do you think that the farm is located appropriately? a) Yes b) No

B/ Is there any opposition by neighbors due to environmental pollution? a) Yes b)No

C/ Is it harmful to raise cattle in urban centers? a) Yes b) No

i) if the answer for C is yes, in what way?

_____

_____

D/ For what purpose do you use animal dung?

a) Sell b) manure c) fuel d) others

16. A/ when did you start selling milk? _____

B/ is there problem of market for your products during fasting? a) Yes b) No

c) Sometimes

C/ What do you do with unsold milk? Mark (✓) in the box

a) Self Consumption b) Distribute to Relatives

c) Convert into butter d) others

D/ who are the major consumers of milk in the market? (Circle one)

a) HH consumers b) Retailers c) business centers

d) Others, specify_____

E/ How do you sell you milk?

a) on contract basis, b) on daily sells basis c) others, specify _____

F/ Select your selling place for your product.

a) At home b) Distribution centers c) home to home selling d) others, specify

_____

G/ how much is the present milk price/liter in the market? _____

17. Do you believe that the prevailing milk price is undermined? a) Yes b) No

18. A) How much hectares of land is your dairy farm? _____

B) What properties (assets) do you have in your dairy farm?

_____

_____

19. Do you think the supply of milk in Mekelle is enough to the Demand? If not why?

_____

_____

20. What problems have you faced in your dairy farm?

_____

_____

21. A/ what are the major types of animal disease?

_____

_____

B/ Possible ways to control transmission?

_____

_____

C/ what are the possible control methods?

_____

_____

ዩኒቨርስቲ መቐለ

ቢዝነስን ኢኮኖሚክስን ፋኮሊቲ

ክፍሊ ትምህርቲ ምትሕብባር ሕብረት ስራሕ ማሕበር

ምርባሕ ናይ ፀባ ከፍትን ዕዳጋን ኣብ ከተማ መቐለ

እዚ ፅሑፋዊ መሕትት እዚ ዝተዳለወሉ ቀንዲ ዕላማ ንኩነታት ምርባሕ ፀባ ከፍትን ዕዳግኡን ኣመልኪቱ መረዳእታ ንምእካብ እዩ።

ተ.ቁ	ናይ መላሳይ ሽም	ዖታ	ዕድመ	ሃይማኖት	ደረጃ ትምህርቲ	በዝሒ ስድራ
1						

1.1. ክንደይ ከፍቲ ኣለዋኹም?

_____ ናይ ፀባ ላሕሚ _____ኣዕሩሕ

_____ዘይ ወላዳኣላሕም _____ ዝራብዓት (ተፈናት)

_____ኣምራኹት

2. ስራሕቲ ምርባሕ ፀባ መደበኛ ስራሕኹም ድዩ? እወ/ኣይኮነን

2.1. ንሕቶ ቁፅሪ ክልተ መልስኹም ኣይኮነን እንተኾይኑ ዋና ስራሕኹም እንታይ እዩ?

ሀ. ሰራሕተኛ መንግስቲ

ለ. ነጋዳይ

ሐ. ዘይስሩዕ ተቐፃሪ

መ. ካልእ ይገለፅ _____

3. ኣብ ስራሕቲ ምህርቲ ፀባ ንክትሳተፍ/ፊዘዳፋፍኣካ (ዘተባብዐካ) ነገር እንታይ እዩ?

ሀ. ትርፋማ ስለዝኾነ

ለ. ናይ ቤተሰብ ምግቢ መጠን ንምዕባይ

ሐ. ከም ናይ ትርፊ ግዜ ስራሕ

መ. ካልእ እንተሃልዩ ይገለፅ _____

4. ንፀባ ላሕሚ እትጥቀሙለን ኣላሕም ካበይ ትረኽቡወን (ዓይነትን)

ሀ. ዝተገዝኣ

ለ. ካብ ናይ ከባቢ ዓሌት ዝተዳቐላ

ሐ. ኩሉ

4.1. መበቆል ዘርኢ ኣላሕምኩም

ሀ. መቐለ

ለ. ካብ መቐለ ወፃኢ ኣብውሽጢ ክልልና

ሐ. ካብ ክልልና ወፃኢ

መ. ሕዋስ ናይዞም ኣብ ላዕሊ ዝተጠቐሱ ይገለፅ _____

ሐ. ካልኦት ይገለፅ _____

5. ኣላሕም ብዝበለፀ ውፅኢት ዝህባሉ ዕድመ (ዘጥቡያሉን ዝሕለባሉን)

ሀ. 1- 3 ዓመት

ለ. 4- 7 ዓመት

ሐ. 8- 11 ዓመት

መ. 12- 15 ዓመት

6. ዓሌት ከፍቲ ብዘርኢ

ሀ. ዘይተዳቐላ ናይ ዓዲ (ዘይተመሓየሻ)

ለ. ዝተዳቐላን ዝተመሓየሻን

ሐ. ሕዋስ ክልቲኡ ዝኾና ዓሌት

መ. ዘይተዳቐላ ፅሩያት

ረ. ኣብ ላዕሊ ናይ ዝተጠቐሱ ሕዋስ ይገለፅ _____

ሰ. ካልእ ይገለፅ _____

6.1. መረፃ ዓሌት ከፍቲ (ብውፅኢታውነት፣ ዝነአሰ ዋጋ፣ ፅሬት ውፅኢት፣ ትርፊ ምህላው፣ ንምቁፅፃር ዝቐለለ ወዘተ)

ሀ. ዘይተዳቐላ ዘይተመሓየሻ
ለ. ዘይተዳቐላ ዝተመሓየሻ
ሐ. ሕዋስ ዓሌት ዘለወን
መ. ዘይተዳቐላ ሓደ ዓሌት ዝኾና
ረ. ጥማር ናይዞም ኣብላዕሊ እንተኾይኑ ይገለፅ

ሰ. ካልኦት እንተሃልዮም ይገላፅ _____

6.2. ቀንዲ ምኽንያት መምረፂኻ/ኺ እዘን ዓሌት

_____

_____

7. እንስሳታት ንምርባሕ ኣንታይ ዓይነት ሜላታት ትጥቀም/ሚ?

ሀ. ኣርቴፍሻል ምርባሕ

ለ. ከበቦያዊ ዝራብፅ (ተፈን)

ሐ. ዝተመረፀ ዝራብፅ

መ. ናይ ኩሉ ሕውስዋስመንገዲ

ረ. ካልእ እንተሃልዩ ይገለፅ _____

8. ኣብ መዓልቲ ዝርከብ መጠን ፀባ ብሊትር

ሀ. ካብ ናይ ከባቢ ዘይተዳቐላ _____ሊትር

ለ. ናይ ከባቢ ዝተዳቐለ_____ሊትር

ሐ. ካብ ክልቲኡ ዓሌት ዝተዳቐላ _____ሊትር

መ. ካብ ምሩፃት ዓሌት _____ሊትር

8.1. ካብዘን ዓሌት እንስሳት ዝለዓለ ትርፊ ዘርክባ እየኖት እየን?

ሀ. ዝተዳቐላ ለ. ዘይተዳቐላ ሐ. ሀን ለን

9. ሕድሕድ ዓሌት ዝህልወን ዋጋ

ሀ. ናይ ከባቢ ዘይተዳቐላ _____ብር

ለ. ናይ ከባቢ ዝተዳቐላ _____ብር

ሐ. ካብ ክልቲኡ ዓሌት ዝተዳቐላ _____ብር

መ. ዘይተዳቐላ ምሩፃት ዓሌት _____ብር

10. ሀ. መበገሲ ካፒታልኩም ብጥረ ገንዘብ ክንደይ ነይሩ?

ሀ. <5000 ብር ለ. 5000-7000 ብር ሐ. 8000-10000 ብር

መ. 11000-13000 ብር ረ. >13000 ብር

ለ. መበገሲ ካፒታልኩም እንታይ ምኽንያት ብምግባር እዩ?

ሀ. ናይ ባዕለይ ሃፍቲ ለ. ልቃሕባንኪ ሐ. ካብ ቤተሰብ ድጋፍ

መ. ልቃሕ ካብ ፍትሓዊ ልቓሕ ረ. ካልእይገለፅ ሰ. ካብ ባንኪ ልቓሕ እንተኾይኑ መጠኑ ክንዳይ እዩ? _____

ሐ. ንሓንቲ ላሕሚ ዝወፀ መጠን ዋጋ?_____

መ. መንበሪ (ገዛ እንስሳት) ንምስራሕ ዝወድኦ መጠን ገንዘብ?_____

ረ. ዓመታዊ መጠን ወፃኢኹም

ምምሕዳራዊ ወፃኢ _____ብር ንመጉዓዝያ ወፃኢ _____ ብር

ንምግቢ እንስሳት _____ብር ንሕውሰዋስ (ዝተፈላለዩ) ወፃኢ _ብር

ሰ. ዓመታዊ መጠን አታዊኹም _____ብር እዩ።

11. ሀ. ዓይነት ምግቢ ንእንስሳት? ንሕድሕድ ዓሌት እንስሳት ዝጥቀማሉ ምግቢ ይገለፅ?

_____

_____

ለ. ፍልፍል ምግቢ እንስሳትኩም

ሀ. ናይ ባዕለይ ለ. ዝተዓደገ ሐ. ካብኩሉ ይገለፅ _____

መ. ካብ ካልእ ይገለፅ _____

I. ዝተገዝአ ምግቢ እንተኾይኑ፣ አበየናይ ወርሒ ትገዝኡ_____

II. ኣብ ሕድሕድ ኣዋርሕ ዝምገበኡ ምግቢ _____

_____

III. ዋጋ ምግቢ እንስሳት ኣብ ሕድሕድ ዓይነት ምግቢ ኣብ ዝትገዝእሉ ግዜ ክንደይ እዩ _____

_____

_____

ሐ. ኣብዚ ሕዚ ግዜ ዘሎ ዋጋ ምግቢ እንሰሰት ምስቲ ሕሉፍ ብኽመይ ተነፃፅሮ/ዮ?

ሀ. ክቡር ለ. ማእኽላይ ሐ. ሕሳር መ. ለውጢየብሉን ረ.ካልእ ይገለፅ_

12. ንመሰተ እንሳስትኩም እትጥቀሙሉ ማይ

ሀ. ካብ ቡንቧ ለ. ካብ ጉድጓድ ሐ. ካብሩባ/ፍልፍል

መ. ካልእ ይገለፅ _____

13. ሀ. እንሰሳትኩም ኣብ ምክንኻን ሓለፍነት ዘለዎ መን እዩ? _____

_____

ለ. ንባዕልኻ/ኺ ኣብ ምርባሕ ስራሕቲ ፀባ ትሳተፍ/ፊዶ?

ሀ. እወ ለ. ኣይፈለይን

ሐ. ኣብ ናሃትኩም ሰራሕ ዝተቆፀሩ ስድራ ኣለዉ'ዶ? ሀ. እወ ለ. ኣይፋሉን

መ. ንመማረሂ "ሐ" መልስኻ/ኺ እወ እንተኾይኑ ኣባኹም ዝተቆፀሩ ሰባት ይዘርዘሩ _____

_____

14. ሀ. ናይ ጉልበት ስራሕተኛታት ዝተቆፀሩ ኣለዉ'ዶ? ሀ. እወ ለ. ኣይኮነን

ለ. ንመማረሂ "ሀ" መልሰኻ/ኺ እወ እንተኾይኑ ብማእኸላይ ክንደይ ኣብሰሙን ይቐፀሩ?

ሀ. 1-2 ለ. 5-7 ሐ. 8-10 መ.11-15 ረ. ካልእ ይገለፅ _____

ሐ. ወርሓዊ መሃያ ሓደ ስራሕተኛ ክንደይ እዩ?

ሀ. 50-100 ለ. 100-200 ሐ. 200-250 መ. > 250

15. ሀ. ናይ እንስሳ መራብሒ ቦታኹም ኣብ ግቡእ ቦታ'ዶ ተቐሚጡ ትብል/ሊ?

ሀ. እወ ለ. ኣይፋሉን

ለ. ንከባቢ ብኽለት ኣመልኪቱ ሕ/ሰብ ዘቅርቦ ኣንፀርፅኖት ኣሎዶ? ሀ. እወ ለ.የለን

ሐ. ኣብ ከተማ ምርባሕ እንሰሳት ከቢድ ድዩ? ሀ.እወ ለ.ኣየኮነን

I. ንመማረሂ "ሐ" መልሰኻ/ኺ እወ እንተኾይኑ ብኽመይ? _____

_____

_____

መ. ናይ ከፍትኹም ዒባ/ዓኾር ንምንታይ ትጥቀምሉ?

ሀ. ንመሸጣ ለ. ንድኹዒ ሐ. ንነዳዲ መ.ካልእ

16. ሀ. ፀባ ምሻጥ መዓዝጃሚርኩም? _____

ለ. ኣብ እዋንያም ፀገም ዕዳጋ እንታይ ይመስል?

ሀ. ኣሎ ለ. የለን ሐ. ሓደሓደ ጊዜ

ሐ. ፀባ ከይተሸጠ ክተርፍለሎ እንታይ ትገብሩ?

ሀ. ንባዕልና ንጥቀመሉ ሐ. ናብ ጠስሚ ንቅይሮ

ለ. ንቤተሰብ ነክፋፍሎ መ. ካልኦት ይገለፅ_____

መ. ኣብ ዕዳጋ ዝለዓለ ተጠቃምቲ ፀባ ዝኾኑ እንመን እዮም?

ሀ. ገዛንገዛ ተጠቀምቲ ሐ. ሻሂ ቤታት

ለ. ናይ ፀባ ፋብሪካታት መ. ካልኦት ይገለፅ _____

ረ. ፀባ ብኽመይ ትሸጡ?

ሀ. ብኩንትራት ለ. በቢዕለቱ እናዞርና ሐ. ካልእ ይገልፅ ___

ሰ. ፀባኹም እትሸጥሉ ቦታ ኣባይ ኣዩ?

ሀ. ኣብ ገዛና ለ. ኣብ መከፋፈሊ ቦታ ሐ. ገዛ ንገዛ እናዞርና

መ. ካልእ ይገለፅ _____

ሸ. ኣብዚ ሐዚ እዋን ዋጋ ፀባ ንሓደ ሊትር ኣብ ዕዳጋ? _____

17. ሕዚ ዘሎ ዋጋ ፀባ ትሑት እዩ ኢልካ/ኪ ዶትኣምን/ኒ? ሀ.እወ ለ. ኣይኮንን

18. ሀ. ንፀባ ከፍቲ ምርባሕ እትጥቀመሉ መሬት ብሄክታር ክንደይ ይኸውን?_____

_____

ለ. ኣብ መራብሒ ፀባ ቦታኹም እንታይ እንታይ ቀረብ አለኩም?_____

_____

19. ኣብ ከተማ መቀለ ዘሎ ቀረብን ጠለብን ፀባ ተመጣጣኒ እዩ ዶ ትብሉ?

እንተዘይኮይኑ ንምንታይ?_____

_____

20. ኣብ ናይ ምርባሕ ፀባ ስራሕኹም ዘጋጠመ ፀጋም እንተሃልዩ?_____

_____

21. ሀ. ዓበይቲ ሕማማት እንስሳት ፀባ ዝብሃሉ እንታይ እንታይ እዩም?_____

_____

_____

ለ. እዞም ሕማማት ንከይሓልፉ ዘኽእሉ መንገድታት ይገለፁ?_____

_____

ሐ. ሕማማት ንምቁፅፃር ዘኽእሉ ሜላታት ግለፁ? _____

_____